(Established 1832.)
AMERICAN ENGINEER AND RAILROAD JOURNAL

NOVEMBER, 1905.

CONTENTS.

*ILLUSTRATED ARTICLES.

EAST MOLINE LOCOMOTIVE SHOPS.

ROCK ISLAND SYSTEM.

I.

The magnificent locomotive repair shops of the Rock Island System at East Moline, Ill., were planned, erected and equipped for operation in less time than is usually required to plan shops of equal size and capacity, and when this is considered in connection with the fact that their cost was very reasonable and that they possess radical features, making their operation very convenient and economical, and that they have been designed with a view to durability and low cost of maintenance, it reflects considerable credit for ability and foresight on the committee which had this work in charge.

On January 15, 1903, a committee, consisting of Mr. George F. Wilson, superintendent of motive power, who was shortly afterwards succeeded by Mr. M. K. Barnum; Mr. C. A. Seley, mechanical engineer, and Mr. S. F. Forbes, assistant purchasing agent, was appointed and authorized to submit plans and recommendations covering the general questions of layout, power, lighting, heating and tool equipment for shops capable of repairing sixty-five engines per month. They were also to consider car department repair shops in regard to general dimensions and location, although up to the present time no provision has been made for their erection. The committee report made to the management, with about three weeks' time for its preparation, was approved, and the committee was continued to assist in making detail plans, specifications and contracts for the equipment and its arrangement. Mr. C. H. Wilmerding, consulting engineer, of Chicago, was engaged to assist with this work, and also undertook the inspection of the erection of the power-house machinery and equipment and all piping and wiring. The buildings were designed and constructed by George B. Swift Company, under the personal supervision of Mr. George F. Jenkins, who was specially well equipped for this work because of his extensive experience in the construction and maintenance of railroad buildings. The work on the buildings was under the general supervision of the chief engineer of the railroad, Mr. J. F. Stevens, and later his successor, Mr. W. L. Darling. Mr. J. M. Brown was appointed engineer in charge for the railroad company. Actual construction was started May 1, 1903; the buildings were completed in a little more than six months, although thirty-one days of that time was entirely lost, due to rain; and the plant was placed in operation the following February.

LOCATION AND CAPACITY.

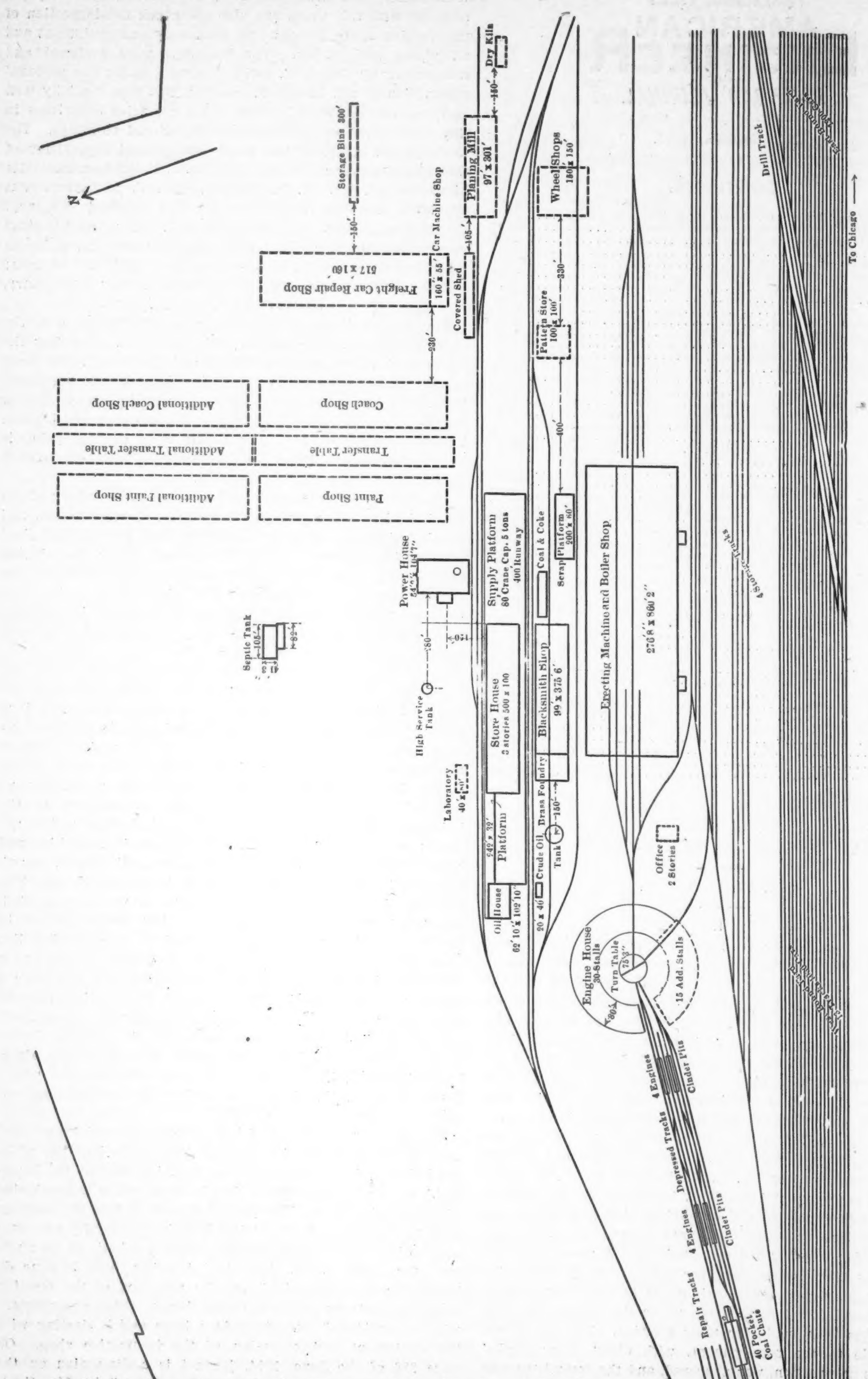
East Moline is about 175 miles west of Chicago, near the cities of Moline, Rock Island and Davenport. Crossing the Mississippi River at Rock Island and Davenport, the Rock Island System diverges in three directions: to the northwest to St. Paul, Minneapolis and Watertown; to the west to Omaha and Denver, and to the southwest to Kansas City and beyond. The importance of having a repair shop at this point is evident from the fact that the four divisions which enter East Moline have about 1,200 locomotives.

The shop site lies in a depression between the valleys of the Mississippi and Rock Rivers, about two miles from each, and is thirty-eight feet above the low-water level in the Mississippi River, which, at this point, rises about fifteen feet during high water. The soil is sandy and very favorable for the construction of the buildings. The shops were designed to turn out about sixty-five engines per month and, in addition, to do manufacturing for the system. The general storehouse for the entire system is located here.

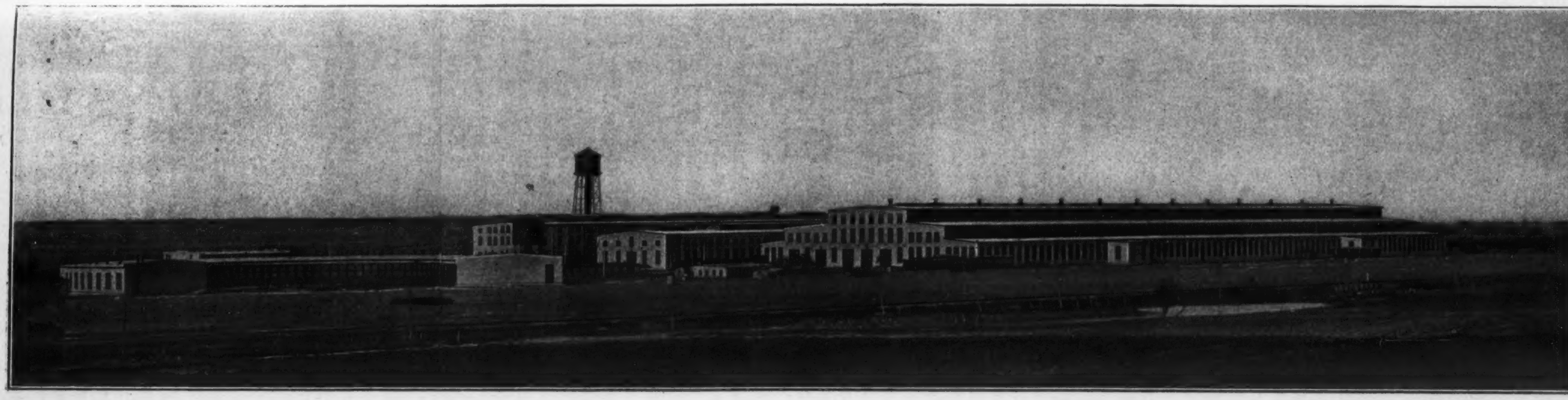
GENERAL DESCRIPTION.

The plot of ground upon which the yards and shops are located is about one mile wide and one and a half miles long and at the time the layout was decided upon it contained no permanent structures or tracks except the main tracks at one side of the property and therefore, unlike many of the recent large shop installations, there were practically no restrictions as to the shape and the arrangement of the buildings. On the layout plan, those buildings which are shown by full lines, which include the erecting, machine and boiler shops, blacksmith shop, storehouse, oil houses, roundhouse and power house, have already been constructed. The buildings indicated by dotted lines have not yet been erected. The freight yards, ash pits and the coaling station are now in the course of construction. The freight yard, which lies between the main track and the shop buildings, is one and a half miles long and five hundred feet wide, and will have a capacity for 3,000 cars. In addition, there are nine miles of track for the use of the shops and storehouse. One track extends through the erecting shop, one through the boiler shop and one through the blacksmith shop, while the storehouse is served by two tracks on each side and the power house by one track. At the east end of the erecting shop are tracks for the storage of wheels.

The erecting, machine and boiler shops are under one roof. The erecting shop occupies the central bay of the building, while the boiler and tank shops are on the side nearest the blacksmith shop, and the machine shop is on the other or south side of the erecting shop. The engines are taken into the erecting shop at the east end, are stripped on longitudinally arranged pits, and are then placed on pits which are built at an angle with the center track. The final erecting work is done on longitudinally arranged pits at the west end of the erecting shop, the end nearest to the roundhouse. This arrangement will be considered more fully in a later article dealing with the equipment and operation of the locomotive shop. On page 236 of the June, 1904, journal is a discussion on the "Track Arrangements in Locomotive Shops," by Mr. C. A. Seley, which considers the advantages of this arrangement



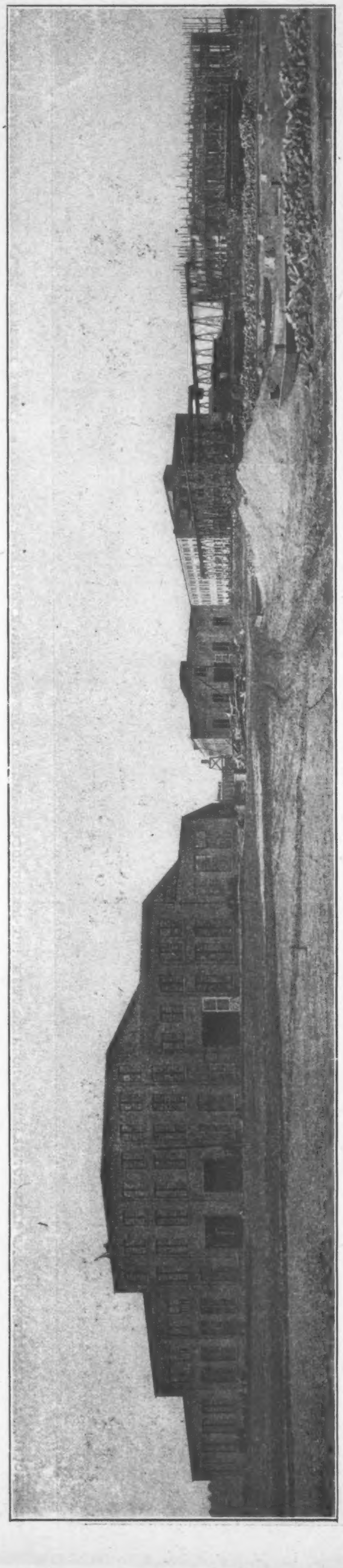
EAST MOLINE LOCOMOTIVE AND CAR SHOPS—ROCK ISLAND SYSTEM.
(Buildings indicated by dotted lines are not yet erected.)



PANORAMIC VIEW, LOOKING FROM A HILL TO THE SOUTHWEST OF THE PLANT.

STOREHOUSE, BLACKSMITH SHOP AND LOCOMOTIVE SHOP, LOOKING FROM THE ROUNDHOUSE. PART OF THE LOW-SERVICE WATER TANK SHOWS AT THE EXTREME LEFT. THE HIGH-SERVICE TANK IS AT THE REAR OF THE STOREHOUSE.

EAST MOLINE LOCOMOTIVE SHOPS—ROCK ISLAND SYSTEM.



LOCOMOTIVE SHOP, BLACKSMITH SHOP, STOREHOUSE AND STORAGE PLATFORM AND CRANE, AND ALSO THE POWER HOUSE IN COURSE OF ERECTION.
EAST MOLINE SHOPS, ROCK ISLAND SYSTEM.

compared with the longitudinal and transverse arrangements. The blacksmith shop, the west end of which is to be used as a brass foundry, is placed between the main shop and the storehouse. The power house, storehouse and supply platforms are placed centrally with regards to the car and locomotive departments, and the blacksmith shop is so placed that it may also be conveniently reached from the car shops. Reference to the layout plan will show that a generous allowance has been made for the extension of all the buildings.

BUILDINGS—GENERAL.

The most striking features about the buildings are the splendid day-lighting, simplicity, absence of all ornamentation and the duplication of detail design, and it is largely these features which made it possible to furnish buildings of strong and durable construction and yet at a relatively low cost ($1.40 per sq. ft. for the machine, erecting and boiler shops, which includes the cost of walls, roofs, floors, crane runways, fan houses, heating, tunnels and engine pits), and it is expected that the cost of maintenance will also be reduced to a minimum. All of the buildings, with the exception of the roundhouse and storehouse, are of brick, with gravel roofs supported on steel trusses. All footings, foundations, pits and conduits are of concrete, consisting of crushed lime stone, not exceeding 2½-inch cubes, coarse, clean, sharp sand and American Portland cement in the proportion of one measure of cement, three of sand and six of stone, the proportion of sand being reduced when the stone ran small. Concrete or cement floors and engine beds have a top dressing ¾-inch thick, with a smooth, level surface. The brick is of the hard burned, common building variety, every seventh course above the foundation being a header course. All fire and battlement walls are finished with vitrified wall coping. The window sills are of Indiana Oolitic lime stone.

The roofs are designed to sustain a force of fifty pounds per square foot. The roof covering is of composition and gravel, and is constructed in the following manner. The sheathing is covered with four thicknesses of wool and roofing felt, weighing not less than fifteen pounds (for single thickness) to a square of one hundred feet; the felt is cemented together the full width of the lap. The roof is then covered with a heavy coating of roof cement and clean screened gravel is applied. The surplus gravel is then brushed off, leaving a coating of one-sixteenth of a cubic yard to a square of one hundred feet.

The windows, clerestory lanterns and doors are all glazed with heavy factory ribbed glass, all one size, 10 by 16, and the window sash and doors are made in standard sizes for all the buildings, and it is expected that this feature will materially affect the cost of maintenance. The windows are generally of two and three flight of sash, all double hung. Where three sash are used, the center one is fitted stationary. The skylights are of the Hayes pattern, with one-quarter inch wire woven glass.

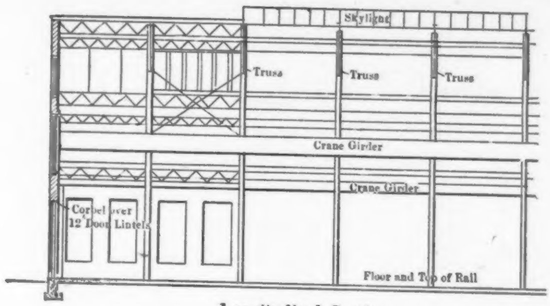
The down-spouts for roof drainage are of cast iron, heavy soil pipe, with leaded joints, and in all cases are brought down inside of the walls and are connected to the sewer with tight cement joints.

The amount of material used in the construction of the buildings will give some idea of their size, and is as follows: 22,000 barrels of Portland cement, 20,000 cubic yards of crushed stone, 5,000,000 feet of lumber, 6,000,000 bricks, 2,400 tons of structural steel, 150 tons of cast iron, 64,000 square feet of factory ribbed glass, 20,000 feet of woven wire glass skylights, and 420,000 square feet of composition roof.

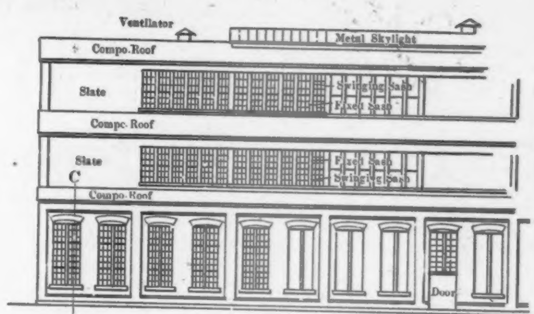
MACHINE, ERECTING AND BOILER SHOPS.

The building which contains these departments is under one roof and covers about five and a half acres; it is 273 feet wide and 860 feet long inside, and is the largest shop of this kind in the United States under one roof, except for the Sayre shop of the Lehigh Valley, which is 360 feet wide and 748 feet long. The Sayre locomotive shop has the boiler shop at one end and two erecting shops, one on either side of the machine shop. Between the machine shop and each erecting shop at

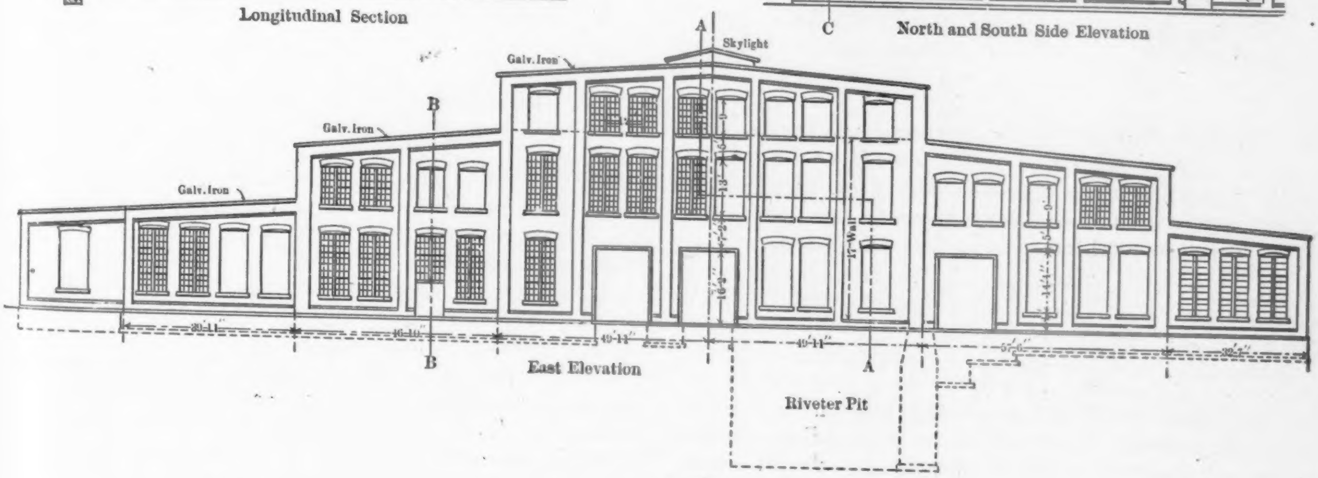
INTERIOR VIEW OF THE LOCOMOTIVE SHOP.



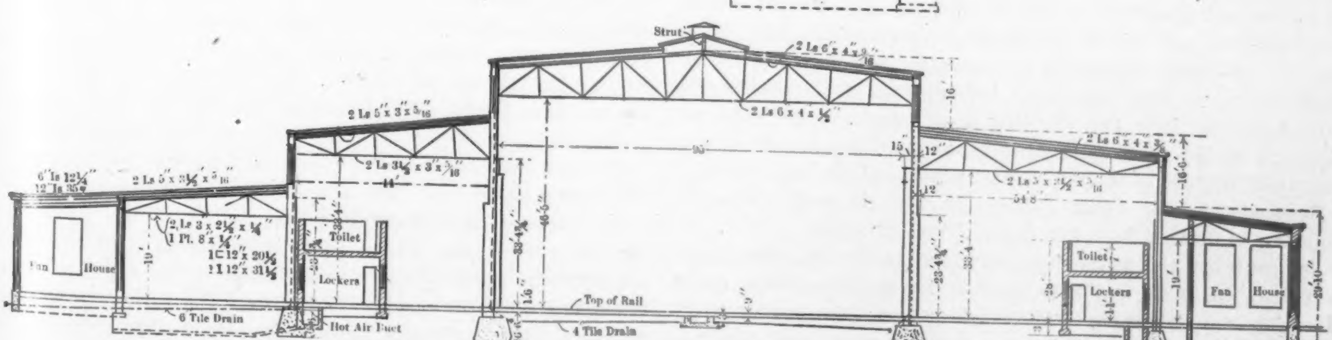
Longitudinal Section



North and South Side Elevation



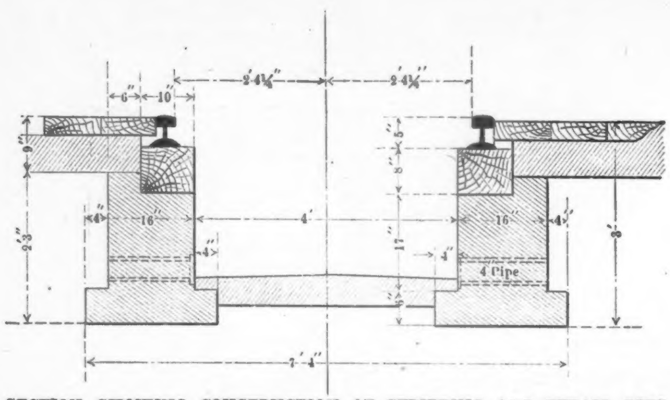
East Elevation



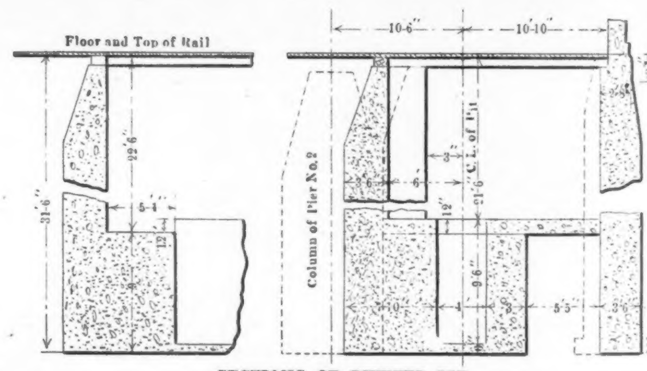
Transverse Section
Looking West

SECTIONS AND ELEVATIONS OF THE LOCOMOTIVE SHOP.

VIEW LOOKING THROUGH THE ERECTING SHOP.



SECTION SHOWING CONSTRUCTION OF STRIPPING AND REPAIR PITS.



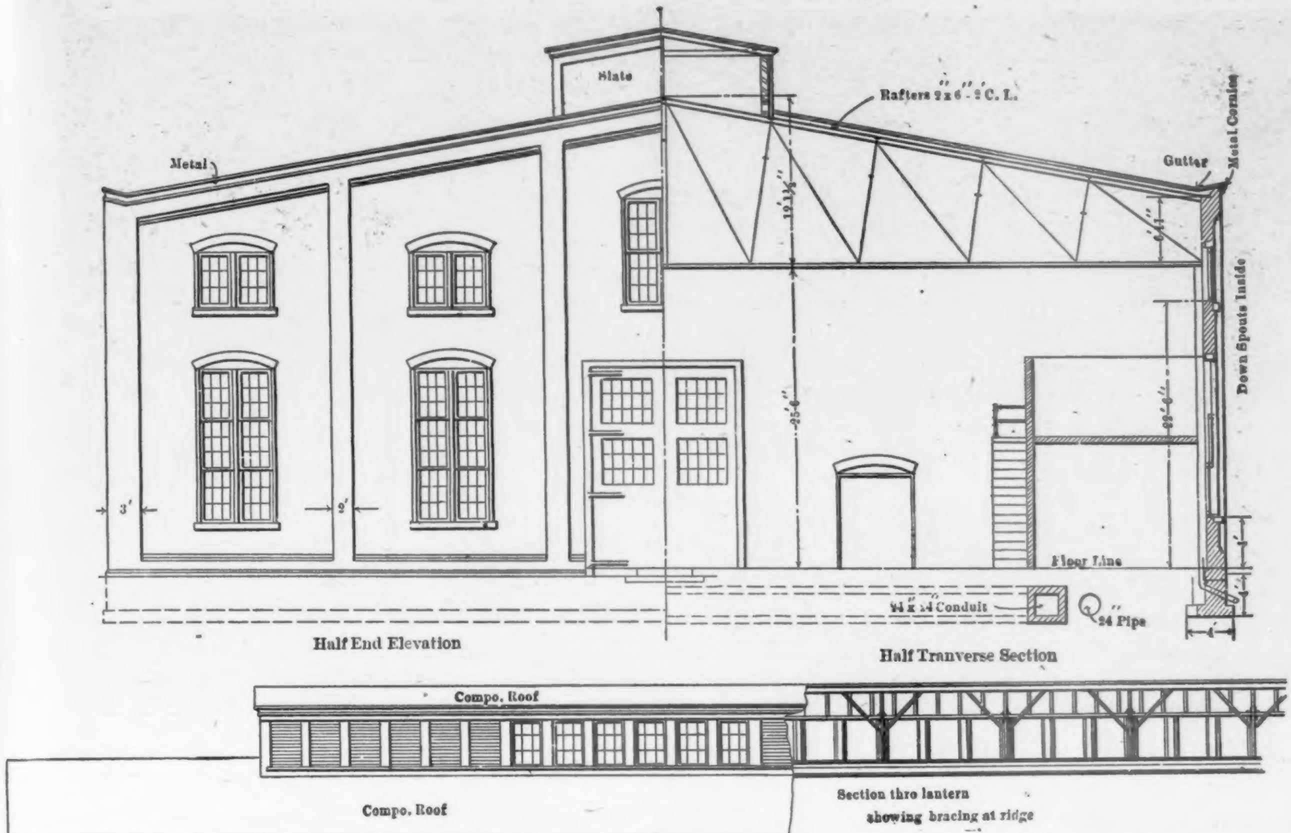
SECTIONS OF RIVETER PIT.

Sayre is a storage space forty-two feet wide, and in the following comparisons this storage space is supposed to be divided equally for machine and erecting shop purposes.

Location.	Ratio.	Total Area. Sq. Ft.	Per Cent. of Total Erecting.	Machine.	Boiler.
Collinwood	1	129,850	28	41	31
Topeka	1.15	149,146	30	44	26
Reading	1.54	196,000	53	23	24
East Moline.......	1.84	233,961	36	31	33
Sayre	2.07	269,280	38	46	16

The percentage limits of the erecting, machine and boiler shops at East Moline are not fixed by walls or boundaries which do not admit of variation, and, as they are all under one roof and not widely separated, the machine shop, if it becomes crowded, can easily be extended over into the boiler shop space, or vice versa, or boiler work may readily be extended over into the erecting shop space. The extreme elasticity of the plan, as regards department boundaries, is an important feature of the layout and is to be highly commended.

Referring to the cross section, it will be seen that this building is divided into five bays. The south bay, 29 ft. 7 in. wide, contains the belt-driven machine tools; the next bay, 46 ft. 6½ in. wide, contains the heavier machine tools, most of which are driven by individual motors; the center bay, 98 ft. 3 in. wide, is used for the erecting shop, and the two north bays, 57 ft. 2½ in. and 32 ft. 3 in. wide, contain the boiler, tank and wood-working shops. The center bay measures 46 ft. 5 in. from the floor to the underside of the roof trusses; the intermediate bays measure 33 ft. 4 in., and the outside bays 19 ft. The roof is supported by steel trusses and purlins with latticed longitudinal girders. The roof trusses are spaced twenty-two feet, center to center, and the side walls have two three-sash windows in each panel between pilasters. The outer side walls are only twenty-two feet high and are largely filled with glass, and this is also true of the clerestory sides, which contain sash 9 ft. 4 in. high. This construction requires a comparatively small amount of brick masonry, which probably accounts to a considerable extent for the low cost of the building. The rafters are 2 in. by 6 in., spaced on two-foot centers, and the sheathing boards are 1⅛ in. D and M. The building contains eight electric traveling cranes, distributed as follows: Two 3½-ton and one 10-ton in the second bay; two 50-ton in the central bay, and one 10-ton and one 20-ton in the fourth bay, and also a 20-ton crane to serve the riveter pit. It will be seen that separate columns support the roof and the crane runways, although these columns are rigidly tied together. The fan houses on the south side form an addition to the main building, while those on the north side are built inside of the north bay. At the east end of the erecting shop is a pit thirty feet deep, in which a 17-ft. hydraulic riveter is placed. This riveter is served by a 20-ton crane, the runway for which is placed above that of the large crane which traverses the full length of the erecting shop.



SECTIONS AND ELEVATIONS OF THE BLACKSMITH SHOP.

The floor is of 3 by 10 in. plank, carried on 4 by 6 in. sleepers, spaced four feet apart. The floor for the south bay, which contains the smaller machine tools, which do not require special foundations, is concrete filled. The 4 by 6 in. sleepers are solidly bedded on six inches of cinders, and the space between the sleepers is filled with concrete. The construction of the pits is shown in detail on one of the drawings. The arrangement of the skylight and lanterns, and also the fact that a comparatively large proportion of the side walls is devoted to windows gives this shop a diffused and excellent light; in fact, it is doubtful whether any other railroad shop in this country is so well lighted. The skylight over the erecting shop is twenty feet wide and is glazed with one-quarter inch wire woven glass in metal frames. The upper windows in the sides of the main clerestory and the lower ones in the clerestory of the wings are pivoted to operate in sections from below.

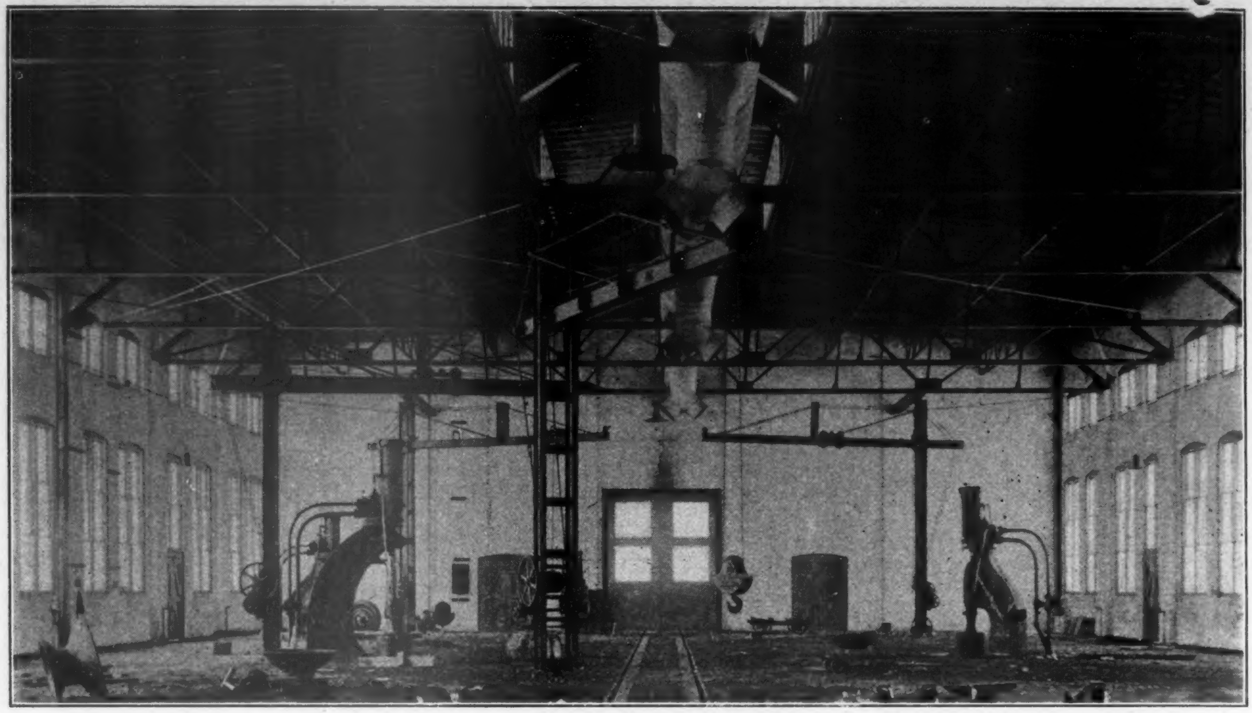
One thousand eight hundred tons of structural steel were used in the construction of this building. It was on hand ready for erection four months after it was ordered, and although it was manufactured at four different plants of the American Bridge Company, the work was so carefully designed and constructed that there was not a single misfit measurement or shop error.

BLACKSMITH SHOP.

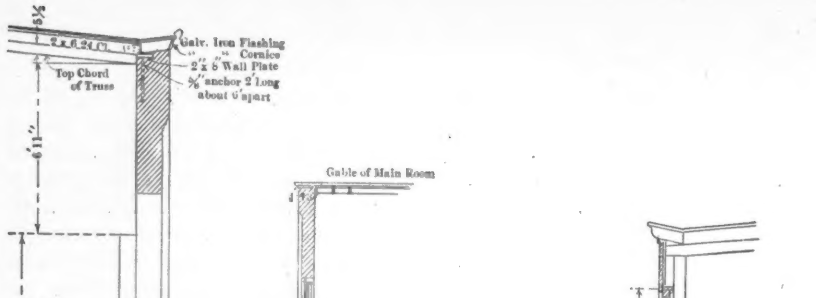
The blacksmith shop is 99 by 465 ft., 85 ft. at the west end being partitioned off for a brass foundry. It lies 50 ft. to the north of the machine shop. The height of the wall is 33 ft. above foundations, and the height from the floor to the underside of the roof truss is 25 ft. 6 ins. This is somewhat higher than usual practice, and is probably to a large extent responsible for the splendid lighting and ventilation of this shop. Although open forges are used, no trouble is experienced from smoke and gas. The walls are of brick, 12 ins. thick, with a 4-in. pilaster, frieze and base outside and an 8-in. pilaster inside. The steel roof trusses rest on the brick walls and are spaced 22 ft., center to center. In each panel between pilasters are four windows, the two lower ones having three tiers of sash, while the upper ones have only a single sash. A ventilating lantern extends nearly the full length of the building, and each alternate panel has a swing sash, while the other panels have inclined wooden slats. The rafters of the main roof are 2 by 6 in. on 2 ft. centers, while those of the lantern are 2 by 8 in. on 2 ft. centers. The composition roofing is placed on 1⅛ in. D and M sheathing. A clay floor is used. A brick wall separates the blacksmith shop from the foundry.

STOREHOUSE.

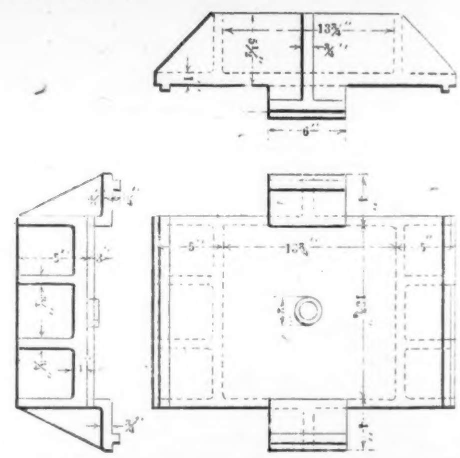
The storehouse building is 500 ft. long, 100 ft. wide and three stories high. It has concrete foundations, brick walls and mill construction of long leaf yellow pine. The first story walls are seventeen inches thick with 4-in. outside pilasters, while the second and third story walls are thirteen inches thick, with 4-in. outside pilasters. The first floor is four feet above the rail of the delivery tracks, and consists of 3-in. plank laid on 4 by 6 in. sleepers, spaced four feet apart, the spaces between the sleepers being filled with cinders. The second story has 3 by 6 in. D and M and the third story 2 by 6 in. D and M flooring. Two stairways lead from the first to the third floor, and there are also two platform elevators, each of 5,000 pounds capacity. The windows on the first floor are placed eight feet above the floor, so that the space may be utilized for storage.



INTERIOR OF BLACKSMITH SHOP, SHOWING ROOF CONSTRUCTION.



SECTIONS OF THE WALLS OF THE BLACKSMITH AND LOCOMOTIVE SHOPS.



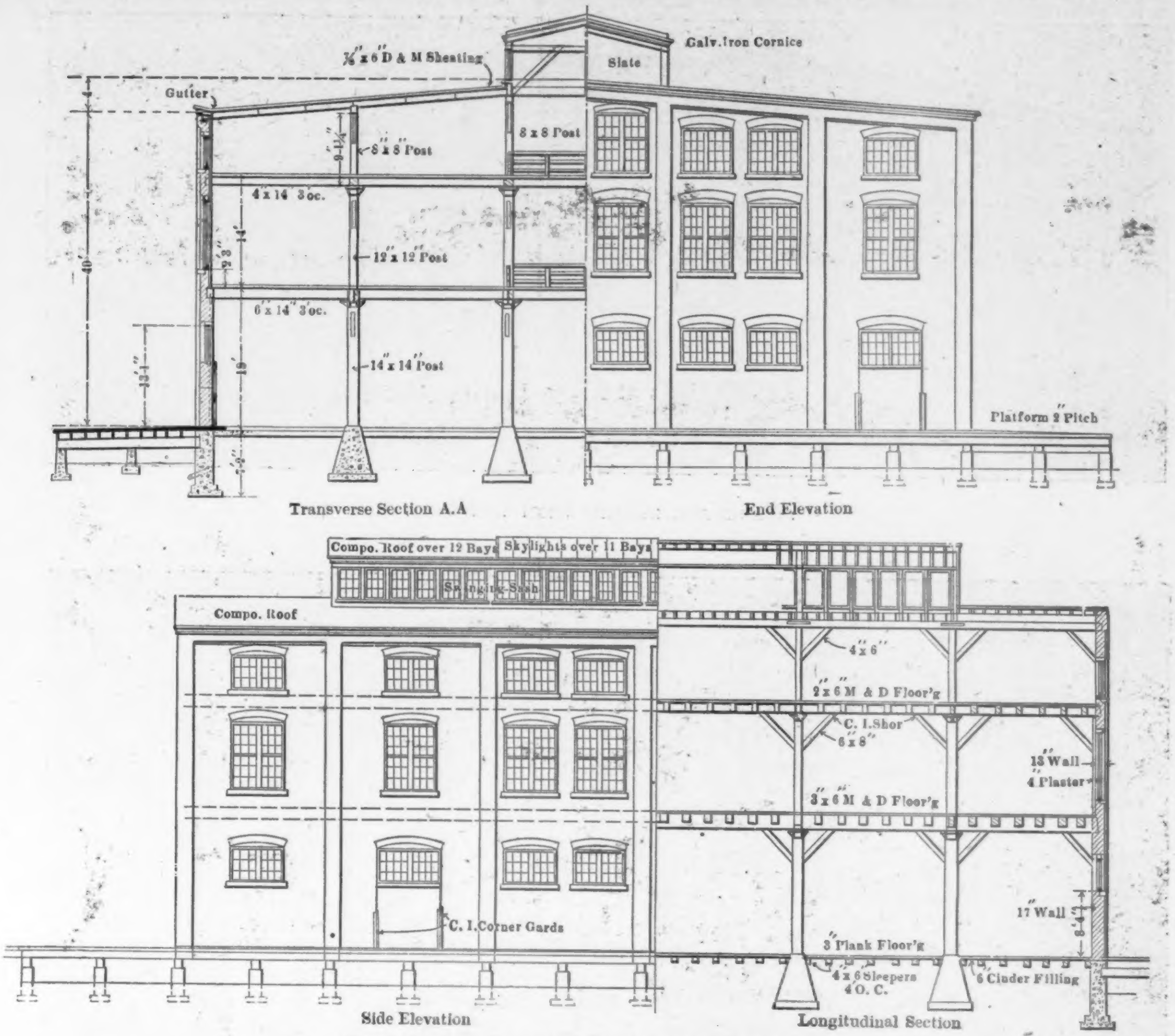
CAST IRON CAPS FOR TIMBER POSTS IN THE STOREHOUSE.

storage platform at the east is 134 ft. 4 in. wide and 400 ft. long. A traveling electric crane of five tons capacity, with an 80-ft. span, extends over one of the delivery tracks and part of the platform for its entire length of 400 ft. A delivery platform, 15 ft. 8 in. wide, extends along each side of the building and at the west end is a platform, 17 ft. 8 in. wide, extending to the refined oil house.

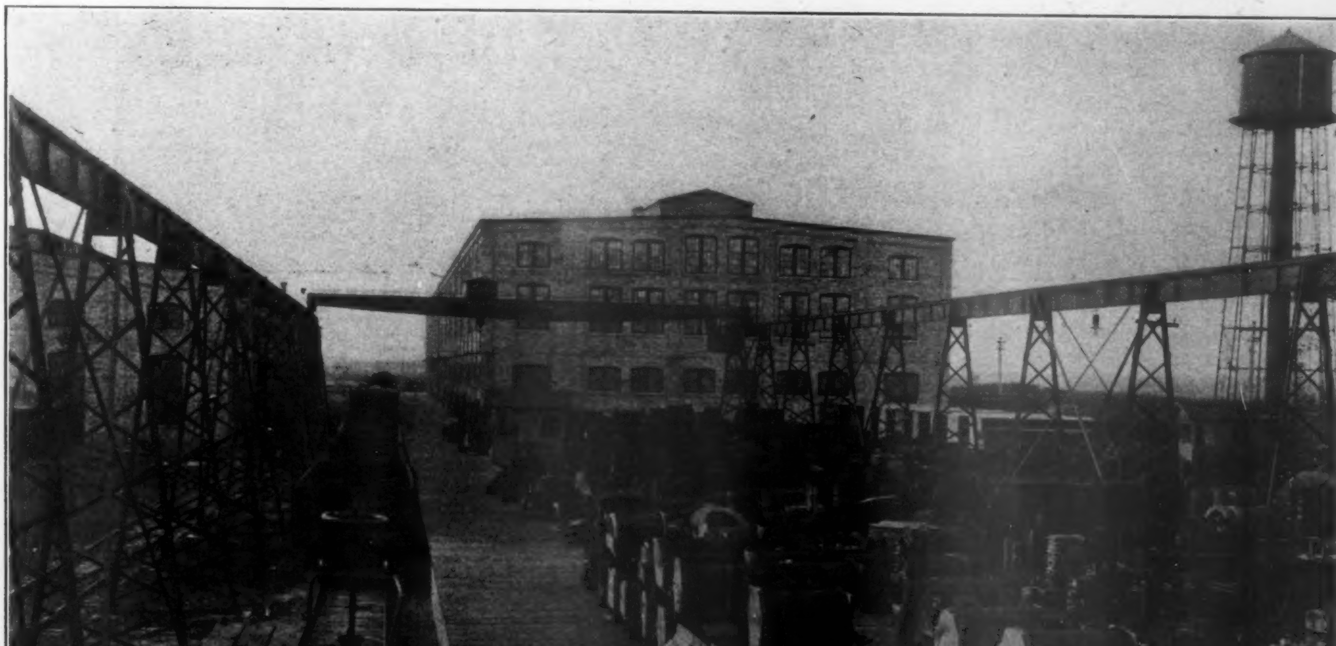
OIL HOUSES.

The refined oil house is 260 ft. west of the storehouse and is 62 ft. 8 in. by 102 ft. 10 in. It has concrete foundations, brick walls and steel roof trusses. The roof composition is carried on 1⅛ in. D and M sheathing and 2 by 6 in. rafters. The building has a basement 59 ft. 2 in. by 59 ft. 4 in., which contains nine storage tanks, six with a capacity of 12,060 gals. each, and three with a capacity of 6,170 gals. each. The basement and first floor are of finished cement, and that part of the first floor over the basement is supported on steel I beams and is reinforced between the beams by No. 16 expanded metal. The basement and first floor are connected by iron stairs. The first floor is four feet above the rails of the delivery track. The building is divided into three parts:

The lantern for light and ventilation is fitted with pivoted windows and a portion of its roof is furnished with skylights. In each floor beneath the skylights are light courts. The brick walls on either side of the doors are protected for a height of about six feet by heavy cast iron guards. The



SECTIONS AND ELEVATIONS OF THE STOREHOUSE.



STOREHOUSE, STORAGE PLATFORM AND CRANE, WITH HIGH-SERVICE WATER TANK TO THE RIGHT.

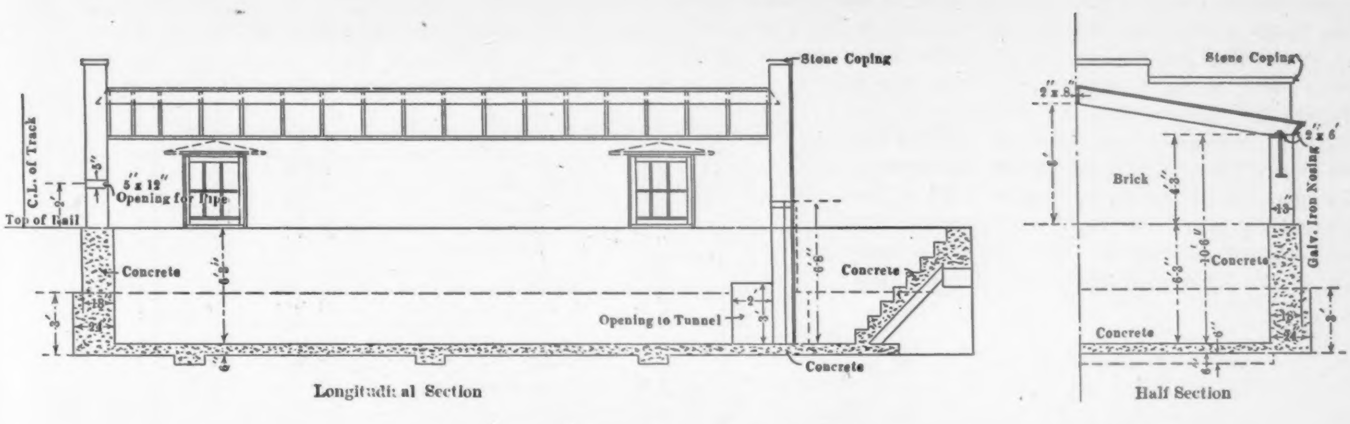
STOREHOUSE, LOOKING FROM THE WEST.

INTERIOR VIEW, SHOWING STOREHOUSE CONSTRUCTION.

SEWAGE DISPOSAL PLANT.

REFINED OIL HOUSE, LOOKING FROM THE SOUTH.

CRUDE OIL HOUSE, REFINED OIL HOUSE IN THE REAR.



SECTIONS OF THE CRUDE OIL HOUSE.

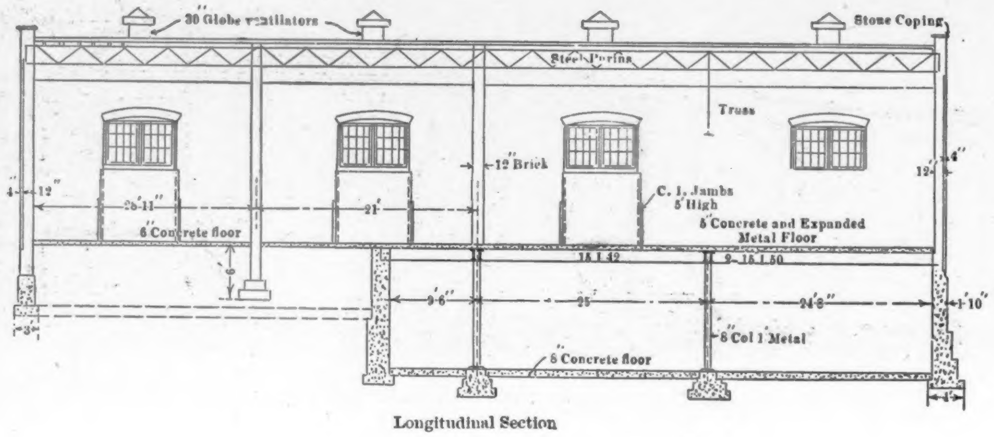
a shipping room directly over the storeroom in the basement, a barrel room, 60 ft. by 20 ft., and a waste room, 60 ft. by 28 ft. These rooms are entirely separate from one another and are steam heated. The building has four 30-in. galvanized iron globe ventilators.

The crude oil house is eighty-nine feet south of the refined oil house and is 35 ft. by 21 ft. The floor is 6 ft. 3 in. below the surface of the ground; the footings, basement walls and floor are of concrete with cement-finished surface. Low brick walls form the superstructure. This house contains two 2,330-gallon tanks, and there is an air-tight manhole in the roof over each tank. Oil is forced from the tanks to a point where it is needed by compressed air. The roof has two 16-in. galvanized iron ventilators. The entrance door is at the east end of the building.

DRAINAGE SYSTEM.

All of the buildings are drained into a system of storm-water sewers, which also take care of the surface water in the immediate vicinity of the buildings. Because of the tunnel which connects the power house with the various buildings, it was necessary to design two systems, one draining off approximately one-half of the buildings to the east and north and the other the half to the west and north. Provision was made for a rainfall of two inches per hour. The sewers range from eight inches in diameter at their beginning to eighteen inches at the outlet, and their total length is 10,600 feet.

The sewage from the toilet rooms is carried in a separate sewer system to a sewage disposal plant. These sewers are six inches in diameter at the beginning, increasing to eight inches at the outlet, and their total length is about 4,700 feet. The sewage disposal plant consists of two septic tanks, with four filter beds for each tank. The tanks hold 35,000 gallons each, and when in full operation should be emptied every twenty-four hours. The filter beds are filled with locomotive front-end cinders, a 4-ft. bed overlaying a layer of twelve



LONGITUDINAL SECTION OF THE REFINED OIL HOUSE.

inches of broken stone. They are each twenty-four feet square, each designed to be in service one-quarter of the time, and they are automatically cut in and out by a mechanism contained in a chamber four feet square at the intersection of each set of four filters.

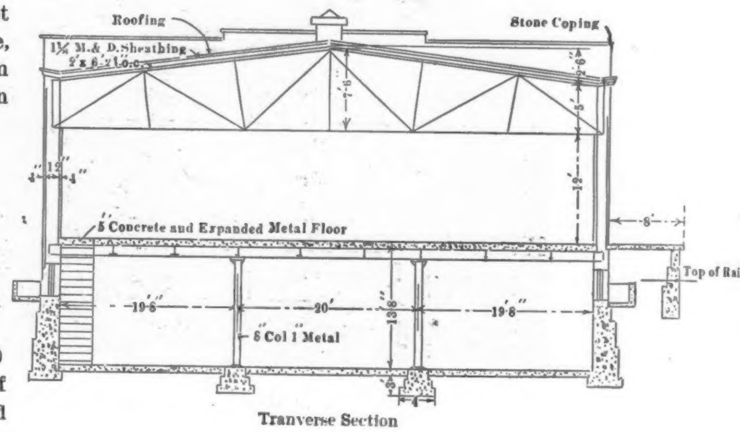
COMMON STANDARD LOCOMOTIVES.

HARRIMAN LINES.

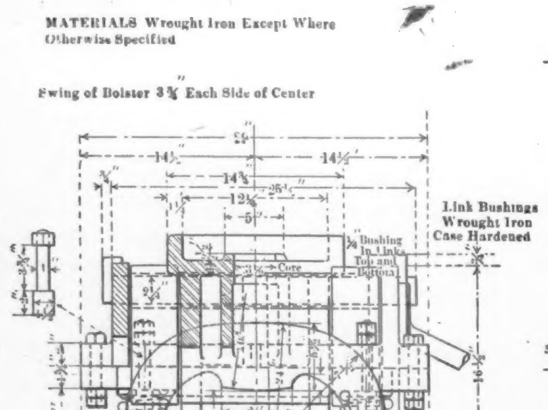
VII.

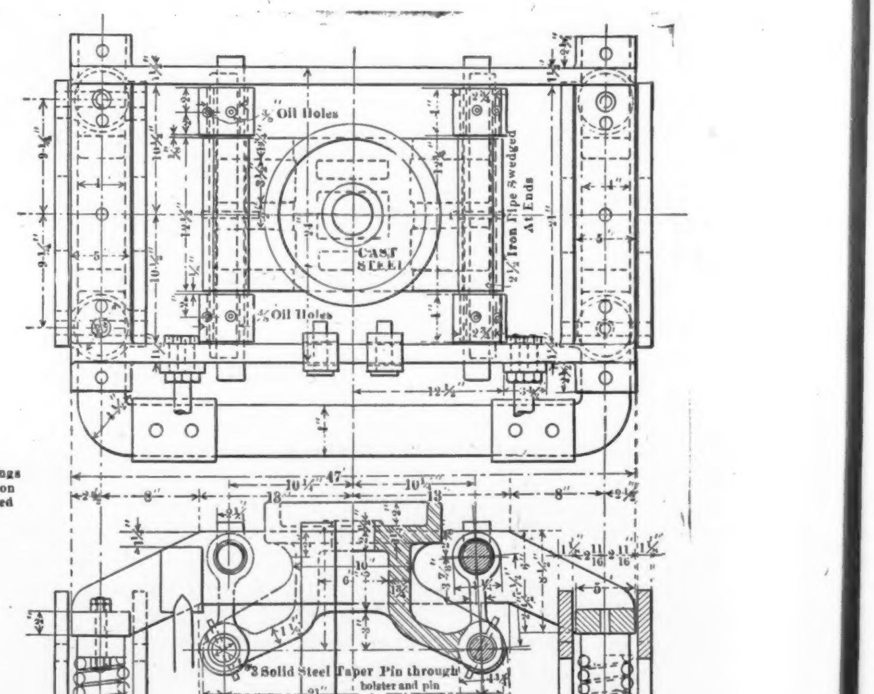
(For previous articles see pages 154, 200, 250, 288, 322 and 353.)

The accompanying illustrations show the construction of the leading and trailing trucks of the Atlantic, Pacific and consolidation classes. The trailing truck of the Atlantic type has inside journals without swing links and is not illustrated. The consolidation type has a cast steel swing bolster pony truck with wrought iron frame, without novelty in its construction. It is illustrated because it represents the standard construction for a very large number of freight locomotives. The journals of the truck wheels of all of the locomotives are 6 by 10 in.; the truck axles are standard throughout. The four-wheel leading truck for the Atlantic and Pacific type

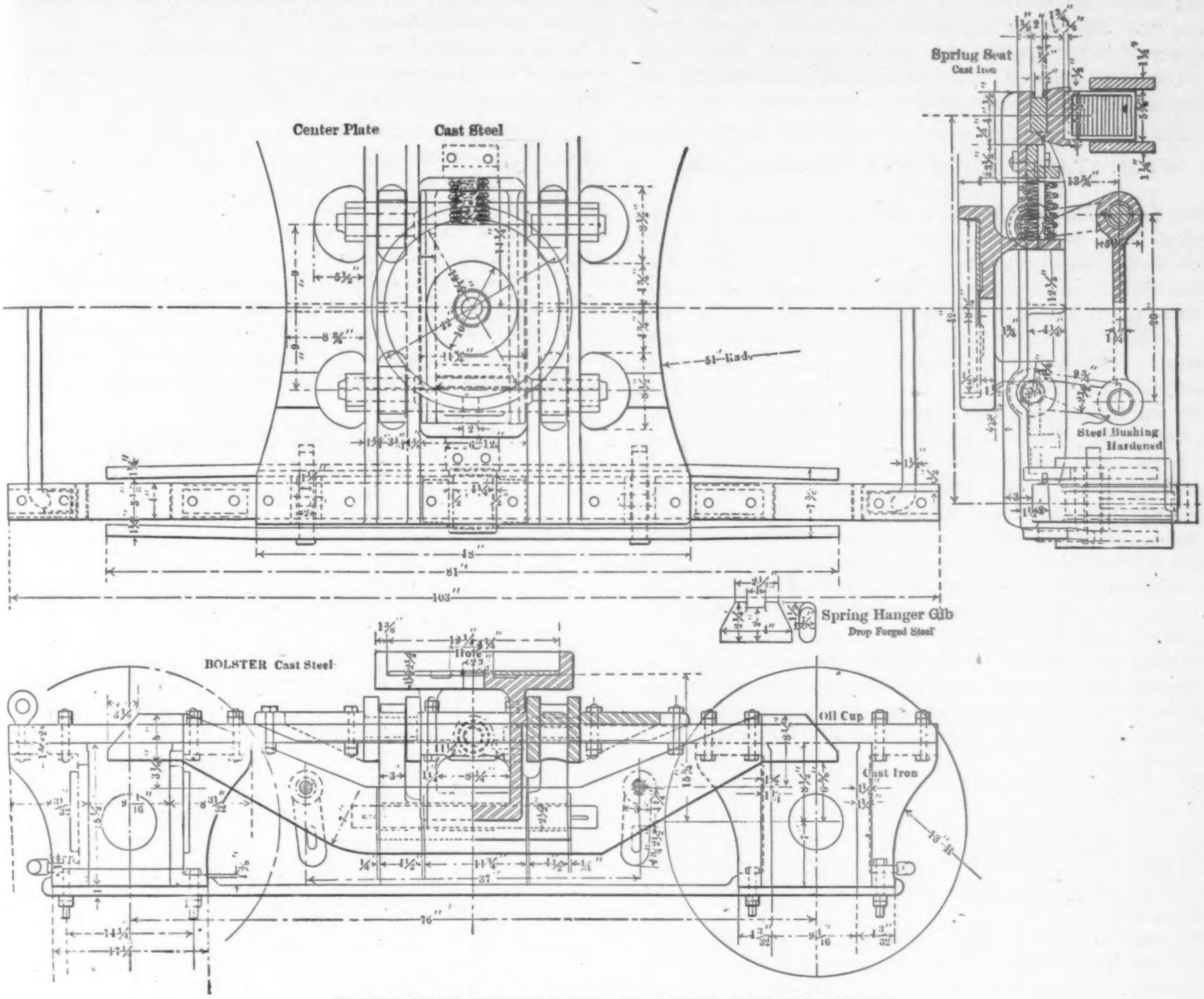


TRANSVERSE SECTION OF THE REFINED OIL HOUSE.

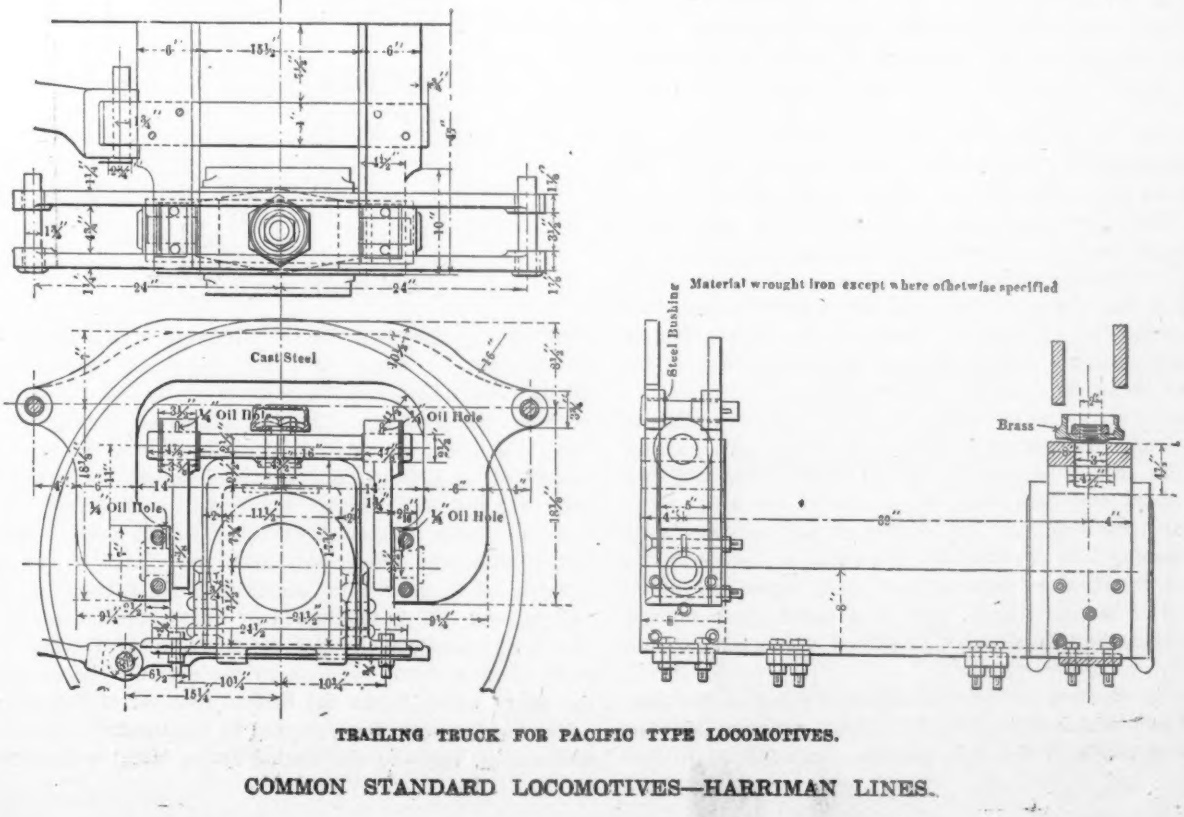




TRUCK FOR CONSOLIDATION LOCOMOTIVES—HARRIMAN LINES.



ENGINE TRUCK FOR ATLANTIC AND PACIFIC TYPE LOCOMOTIVES.



TRAILING TRUCK FOR PACIFIC TYPE LOCOMOTIVES.

COMMON STANDARD LOCOMOTIVES—HARRIMAN LINES.

locomotives employ swing links combined with a spring centering device, the construction of which is illustrated in the engraving. The saddle and swing bolster are of cast steel, otherwise this four-wheel truck does not employ construction which is at all unusual. The Rushton trailing truck for the Pacific type passenger locomotive is illustrated. This construction has been referred to before in these pages. The swing links are 11 ins. long between centers, and are loaded by the cast steel equalizers.

We are indebted to Mr. W. V. S. Thorne, director of purchases of the Harriman Lines, for this information and to the Baldwin Locomotive Works for the drawings.

50-TON STEEL TWIN HOPPER GONDOLA CAR.

The Lake Shore & Michigan Southern Railway has just received from the American Car & Foundry Company 1,000 50-ton steel twin-hopper gondola cars, which are constructed almost entirely of structural steel, and are notable because of several radical departures from ordinary designs. The cars are designed to carry a load 20 per cent. in excess of their nominal capacity, and will carry fifty tons of ore loaded directly over the hopper doors. They are intended as a general utility car for carrying such materials as coal, coke, ore, pipe, pig iron, rails, structural material, etc. The door openings are large and unobstructed, so that coke may easily be unloaded through them. The sides and top of the car are made especially strong and stiff, so as to adapt it for use on unloading machines and for carrying heavy structural material loaded on the top of the sides. The rivets in the floor of the car are driven with a special flat head to avoid countersinking, and the floor plates are so arranged as to facilitate the handling of coal or ore with shovels. Special care was taken to arrange the inside of the car so that the entire load would be emptied when on the unloader, as it has been found that, with the ordinary construction, considerable coal or ore does not slide out. The general dimensions are as follows:

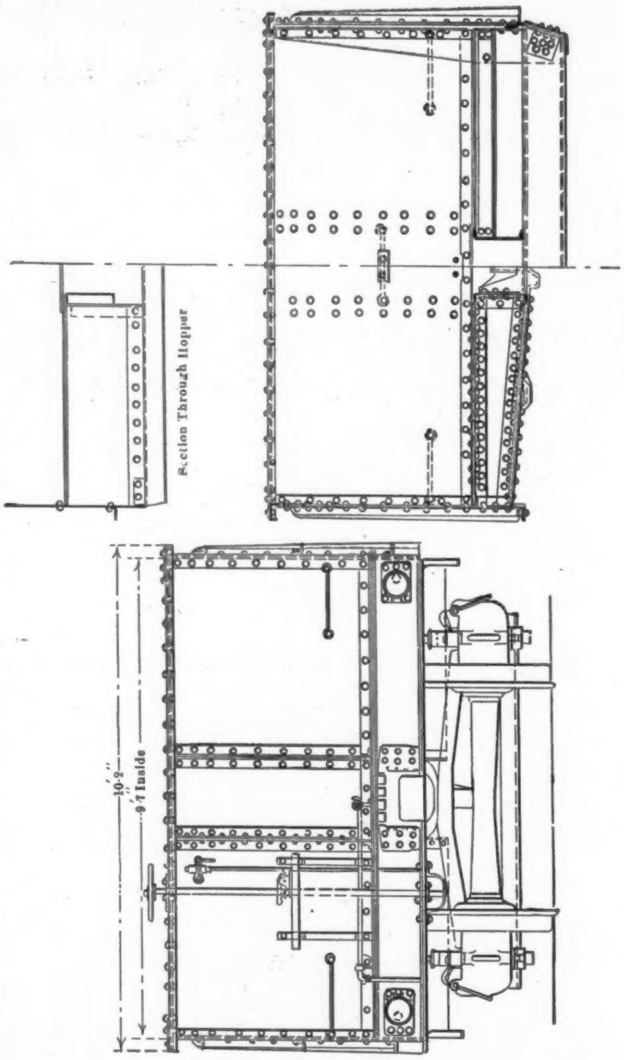
Length over end sills	38 ft.
Length inside	36 ft. 6 ins.
Width over sides	10 ft. 2 ins.
Width inside	9 ft. 7 ins.
Height inside	4 ft. 2 ins.
Height from top of rail to top of side	7 ft. 10¼ ins.
Height to lower face of center sills	2 ft. 8 ins.
Size of door openings	2 ft. 8½ ins. by 3 ft. 11⅞ ins.
Wheel base of trucks	5 ft. 5 ins.
Center to center of trucks	27 ft. 5 ins.
Weight of car	38,600 to 39,000 lbs.

The center sills are of 12-in. channels, 20.5 lbs. per ft., and extend through the body bolster and have 12-in. channel draft sills spliced to them. This splice is especially strong, as may be seen by referring to the detail drawing showing the application of the Westinghouse friction draft gear. Splice plates are placed on either side of each sill, the outer, or longer, plate taking the nine rivets, which hold the draft lug, while the draft lug itself butts up against the shorter inside splice plate, and thus prevents any tendency to buckle at this point.

The car is so designed that the center sills carry only a small proportion of the load. The load at the center of the car is transmitted to the side girders by means of the cross girder, consisting of two channels placed back to back. The details of the connection of this girder to the side sheets are unique. The gusset plate on the inside of the car passes down through the floor and between the members of the cross girder and is securely riveted to it. An inside plate, which is riveted to the lower part of the side sheet, passes down over the ends of the girder, is riveted to the bottom flanges of the girder channels and is also attached to the web of the channels by means of angles as shown.

Each side of the car is composed of four sheets, two of them extending from the bolsters to the ends of the car, so that they may be readily renewed in case of accident, and two extending from the bolster to the center of the car. The joint of the side sheets at the center of the car was very carefully designed, as the sides at this point are subjected to the most severe stresses, especially at their upper and lower edges. It will be noted that there is a splice plate on the inside and that the side stiffener fulfills this function on the outside.

Attention is directed to the channel at the top of the side and end sheets, which adds greatly to their stiffness sidewise and to the strength of the side girders. In addition to the gusset plates at the middle there are four other gussets on each side of the car. The sides are stiffened opposite each hopper door by pressed steel siffeners placed horizontally on the inside of the car, the angle of the projection on these stiffeners being such that coal or ore will readily slide off of it. It will be seen from the drawing showing the arrangement of the drop doors that the hopper sheet is riveted to the top of the center sill and passes down over it in such a way that it is impossible for any of the lading to lodge in the channels. Each end sheet is stiffened by the two gussets on the outside.

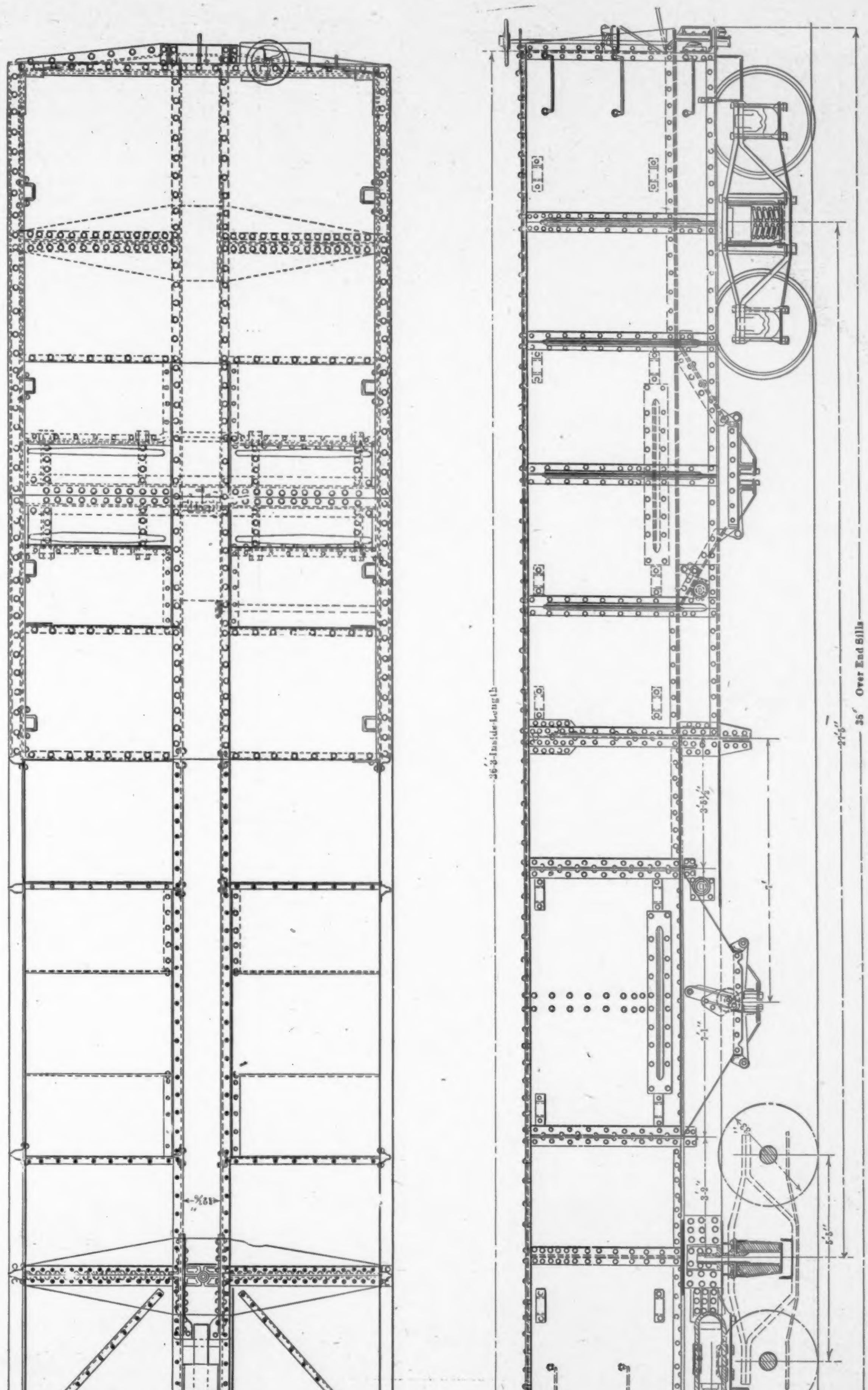


CROSS-SECTIONS. END VIEW.
50-TON STEEL TWIN HOPPER GONDOLA CAR.

Referring to the plan view it will be seen that the end sill is not straight, but slopes back from the center so that there will be no opportunity for the corners of the cars crushing each other on sharp curves. The floor plates are turned upwards at the sides and are riveted to the side sheets. Floor stiffeners, consisting of light channels, extend across the car at proper intervals and also diagonally across at each corner.

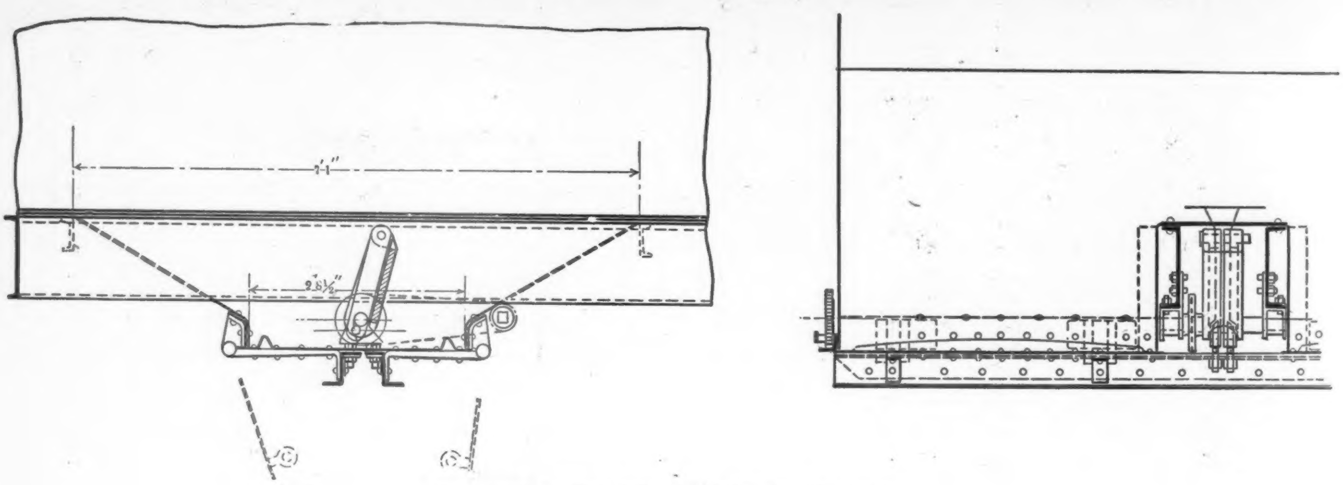
At the body bolster a filler casting is used between the center sills, and the bolster from the center to the side sill consists of a plate with angles riveted at both the top and bottom, and this is reinforced by heavy top and bottom cover plates which extend the full width of the car, the bottom cover plate passing down underneath the side and being riveted to the angle which forms the bottom member of the side girder.

The hopper doors are operated by the Dunham type drop-door mechanism, made by the United States Metal & Manufacturing

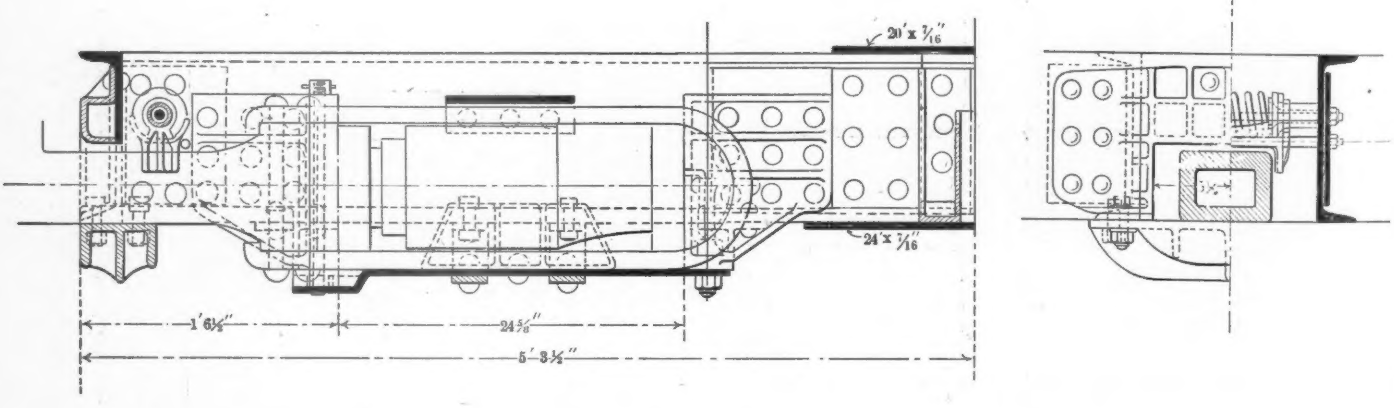


PLAN AND SIDE ELEVATION OF 50-TON STEEL TWIN HOPPER GONDOLA CAR.—LAKE SHORE & MICHIGAN SOUTHERN RAILWAY.

50-TON STEEL TWIN HOPPER GONDOLA CAR—LAKE SHORE & MICHIGAN SOUTHERN RAILWAY.



DROP-DOOR MECHANISM—50-TON GONDOLA CAR.



APPLICATION OF WESTINGHOUSE FRICTION DRAFT RIGGING; ALSO SHOWING METHOD OF SPLICING DRAFT SILLS TO CENTER SILLS—50-TON GONDOLA CAR.

Company. This device is very simple and is positive locking. The chain is used merely to close the doors, which it does by operating the crank, and when the crank center is once past the center of the doors all load is taken off the chain and the load of the doors tends to throw the crank center farther to the right, but this is impossible because of the construction of the crank casting, as may be seen by reference to the drawing. The chain is also used to throw the crank to the left and thus open the doors. The wrench which operates the shaft upon which the chain sprocket is keyed is so designed that when the crank center passes to the left of the center of the doors and the load causes the doors to open with considerable force, the wrench slips off the end of the shaft and the operator is not liable to injury. As the center of the doors is not coincident with the center of the crank it is necessary to use a longer hanger for one of the doors, and this causes one door to close before the other, and when both of the doors are completely closed one of them forms a "ship lap" over the other. It will also be noticed that the doors close up tightly under the hopper opening and that there are no flanges on them which fit up into the opening and cause the doors to get out of order if the car gets out of alignment.

The doors are stiffened by Z bars, which are reinforced by the bent plates, and extend the full width of both doors, and also by the projection which is pressed in the upper side of the door near its edge. The edges of the hopper opening are reinforced by the bent plates which extend crosswise. The door hangers are of flanged steel.

A simple, efficient and substantial centering device, made by the United States Metal & Manufacturing Company, centers the coupler and provides for an excess amount of side play, thus relieving the strains on the underframe and on the coupler and its component parts when on curves, and it also reduces wheel-flange wear and strain on the trucks and greatly simplifies the matter of coupling on curves.

Except for the journal and pedestal bolts for the Simplex trucks, which are fitted with double nuts, these cars are equipped throughout with Columbia lock nuts, which, for this class of work, are considered equivalent to rivets, except that, if necessary, the nuts may readily be removed. We are indebted for information and drawings to Mr. H. F. Ball, superintendent of motive power of the Lake Shore & Michigan Southern Railway, and to the American Car & Foundry Company.

FLUES WITH REDUCED FIREBOX ENDS.

By Don Sweney.

Reducing the firebox end of locomotive boiler flues to about ⅛ inch less than the nominal diameter for a distance of about eight inches from the flue-sheet has been practiced to a limited extent, but does not seem to come into much favor, nor does any definite conclusion seem to be arrived at as to the value of such a practice. In my acquaintance with the subject it seems to me it has always been presented wrong, argued and discussed on the wrong assumptions and experiments made with the wrong end in view. Advocates of reduced-end flues explain that with 2-inch flues spaced 2 11/16 in. between centers and so having the usual 11/16 in. space between them, the flues can be reduced to 1⅞ in. diameter at the firebox end for a short distance—6 or 8 in.—and thereby obtain 13/16 in. flue-sheet bridges and circulating space between the flues at the point where the generation of steam is very rapid and circulating space most needed. A trial of such flues many not show the advantage expected, or it may not be possible to detect the advantage if it does exist, and this practice therefore stands, like some other practices or designs, on its theoretical merit. The fact of the matter is, that under the circumstances which the reduced-end flues are tried and not found to be of any value the wider space obtained between the flues is not needed, and therefore gives no appreciable benefit over the regular space obtained between the full-sized ends.

It is still true, however, that more space is needed between the flues near the back flue-sheet than is required farther ahead in the boiler, and that if 11/16 in. space between the flues at and near the flue-sheet is sufficient, 9/16 in. space is undoubtedly sufficient for the remainder of the flue length. Therefore the 2-in. flues with 1⅞ in. back ends might be spaced 2 9/16 in. between centers, giving the required 11/16 in. space between the flues at and near the back flue-sheet where it is needed, and 9/16 in. space between the flues for the remainder of the length where that spacing is sufficient. The fact that the steam evaporated from the flue-sheet, as well as that from the first 2 or 3 in. of the flues, must pass up between the flues in about that portion of their length, and that the evaporation per square inch from the back end of the flues is the greatest, decreasing in each consecutive portion of the length toward the front in about the same proportion that steam pressure decreases by expansion, it seems that a reduction of the back ends of the flues for a distance of about 6 or 8 in. ought to be sufficient.

With 2-in. flues having the back ends reduced to 1⅞ in. and compared with the same size flues spaced the same distance between centers, but having full-sized ends, the circulating space near the back flue-sheet and the back flue-sheet bridges is increased about 19 per cent., the draft area of entrance to the flues is decreased about 13.8 per cent. and the draft resistance due to entrance to and exit from the flues is increased about 6.9 per cent., the draft resistance due to friction of the gas passing through the flues remains the same and the heating surface and flue volume remain about the same; therefore, if there is no requirement for the wide bridges and circulating space, this form of flue end with this spacing is a disadvantage to the extent which it obstructs the draft.

With 2-in. flues having the back ends reduced to 1⅞ in. diameter and spaced ⅛ in. less between centers than flues having full-sized ends and compared with 2-in. flues having full-sized ends and the regular spacing, the width of the back flue-sheet bridges and the circulating space near the back flue-sheet remain the same, the number of flues is increased 10 per cent., with a consequent increase of heating surface and flue volume, the draft area of entrance to the flues is decreased about 5 per cent. and of exit increased 10 per cent., whereby the draft resistance due to entrance to and exit from the flues is reduced about 2½ per cent., and the draft resistance due to friction of the gas passing through the flues is reduced about 10 per cent.

The possibility of gaining 10 per cent. effective heating surface and flue volume in a boiler, with no more additional weight than that of the flues added ought to make this design of flue ends and flue spacing a valuable feature of boiler design.

Shop Foremen.—There is one thing that I wish to lay particular stress on, and that is the matter of supervision. I doubt if any of the railroad shops in this country have too many foremen; there are certainly many shops which have not enough foremen. It is not economical to require much clerical work of a foreman, for almost any foreman can waste the monthly salary of a clerk every day in the week if he is tied down at a desk. The difference between good and poor foremen is also often underrated, and it is not uncommon for a railroad company to allow a good foreman to leave rather than pay him a few dollars more a month or to retain a poor foreman simply because they think he is cheap. The wastefulness of poor foremen is not generally realized. I know one case where a foreman was not satisfactory, and the management was advised that $500 a month could be saved by putting in an efficient and up-to-date man. This finally was done, and within 90 days after the change the new man had saved $1,300 a month in labor alone and was producing more and better work than his predecessor.—*Mr. M. K. Barnum, before the Western Railway Club.*

PRODUCTION IMPROVEMENTS.

Milling Cast Steel Driving Boxes.

For some time past it has been the practice at the Angus shops of the Canadian Pacific Railway to machine driving boxes for new equipment on a slab milling machine instead of a planer. The sides of the boxes are milled with a high-speed steel inserted tooth cutter, 8 in. in diameter and 30 in. long, as shown in Fig. 1. The machine is a heavy motor-driven, 48-in. Bement-Miles & Company horizontal miller. On cast steel a cut ½ in. deep, with a feed of 1⅜ in. per minute may be taken at a speed of 30 r.p.m. With lighter cuts the feed may be increased. Twelve driving boxes (two rows of six each) are placed on the machine at one time. Because of the roughness of the cast steel boxes, more time is required to set them up than for cast iron. As many as 20 cast steel boxes, for 9 and 9½ in. journals, have been machined on both sides in a day of ten hours, and 30 cast iron boxes for 8½ in. journals have been machined in ten hours.

The shop has only one of these 30-in. milling cutters, and this has been in use for the past twelve months, and in that time has machined all the driving boxes for the following new equipment: 25 6-wheel switch (cast iron boxes), 25 10-wheel freight (cast steel boxes) and 6 Pacific type passenger engines (cast steel boxes), and in addition to this it has been used on some repair work. While the cutter is worn considerably, it is still good for another lot of at least 25 new engines. This cutter has been used largely as an experiment and was probably abused to some extent before the most suitable feeds and speeds for different materials and the proper methods of lubrication were determined upon, and therefore a second cutter will undoubtedly last longer. Some little experimental work was also required to determine the length of time which the cutter should be run before regrinding. A cutter of this kind can satisfactorily mill 42 cast steel boxes (84 sides) before regrinding, although these boxes are rough, sandy and uneven.

It has been found that in milling cast steel it is very important that a good stream of soda or compound be forced onto the cutter, and the suggestion is made that milling machines to handle this class of work should be provided with a large capacity pump and have a comparatively large reservoir on top of the housing. Two pipes could run down from the reservoir to the cutter and each one end in a T with a large number of small holes in it, so that a good stream of lubricant could be forced onto the cutter over its entire length.

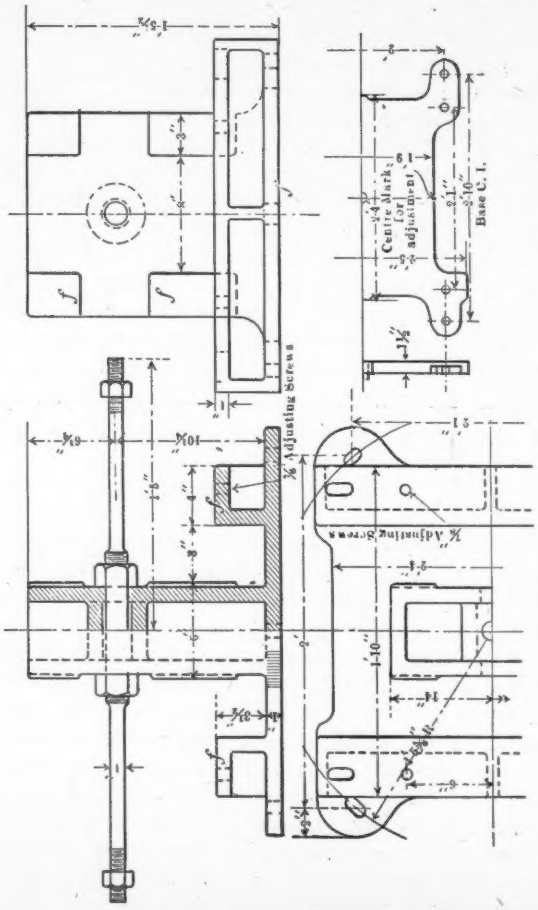


FIG. 3—JIG FOR HOLDING DRIVING BOXES WHILE MILLING THE SHOE AND WEDGE FITS.

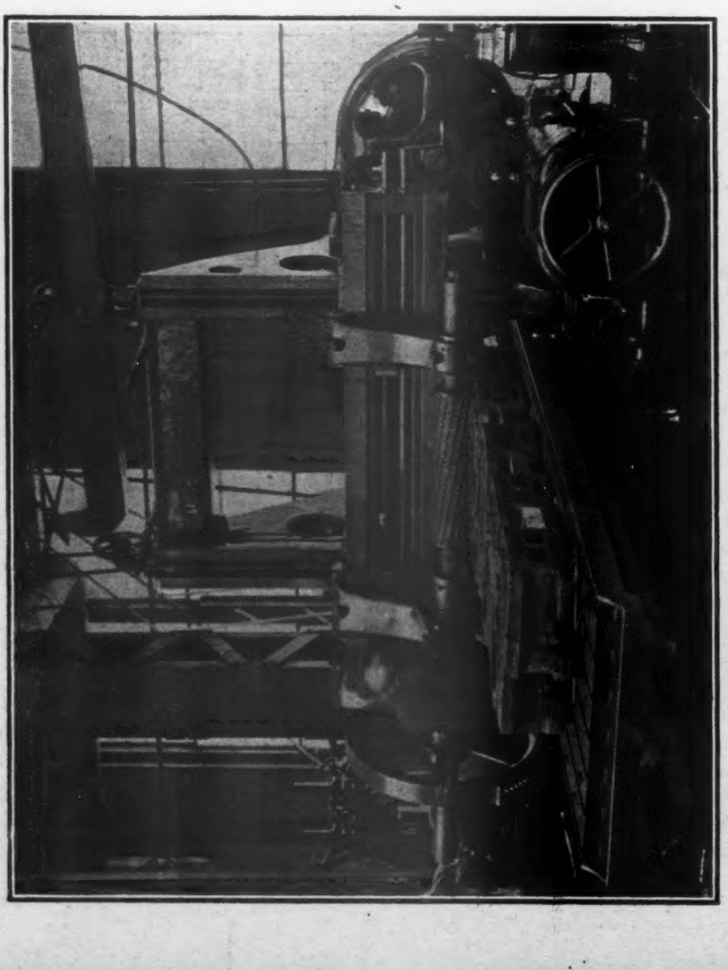


FIG. 1—MILLING THE SIDES OF THE DRIVING BOXES.

FIG. 2—MILLING THE SHOE AND WEDGE FITS.

Fig. 2 shows the method of milling these boxes for the shoe and wedge fits. The cutters are 12 in. in diameter of the high-speed steel inserted plate type. It will be seen that each tool is made in two pieces, and that the cutters overlap each other. It is thus possible to vary the width of the cutters and thus keep them up to standard size. These cutters will mill about 30 boxes without regrinding. In cutting cast iron they run at 12 r.p.m. and feed at the rate of 1⅜ ins. per min., while in cutting cast steel they may be run at 15 r.p.m. with a ⅝-in. feed per min. Fig. 3 shows in detail the jig for holding these boxes. The base plate of the jig is bolted to the table of the miller, and the jig is pivoted on this plate and may be set at any desired angle. The jig holds two boxes, which are clamped to its side by means of a long stud, and the box is adjusted for height by means of the two adjusting screws, and is clamped at both the front and back. One man will mill the shoe and wedge fit for at least 12 cast iron boxes (8½ to 9½-in. journals) in a day of 10 hours or 8 cast steel boxes of the same size. We are indebted for this information to Mr. H. H. Vaughan, superintendent of motive power; Mr. H. Osborne, superintendent of shops, and Mr. Gustave Giroux, piece work inspector.

10-WHEEL PASSENGER LOCOMOTIVE.

DELAWARE, LACKAWANNA & WESTERN RAILROAD.

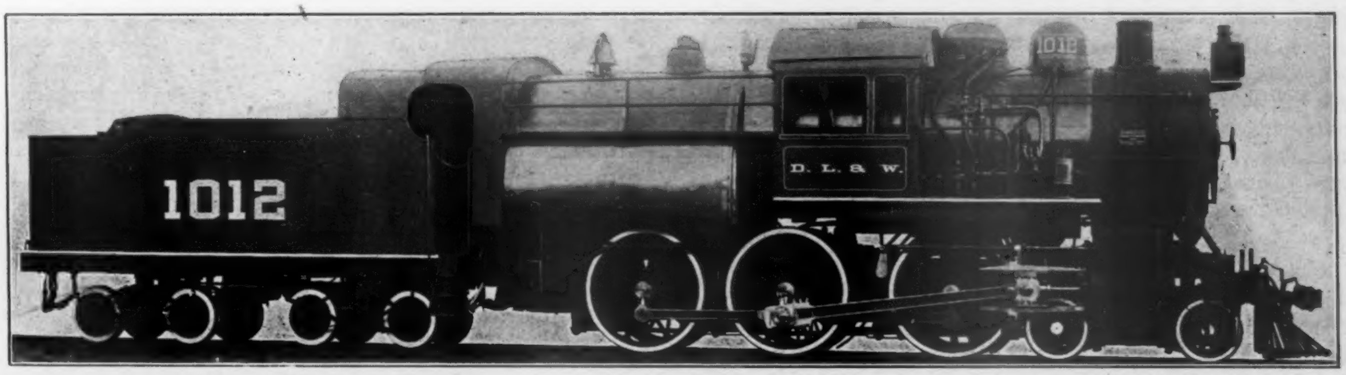
The Delaware, Lackawanna & Western Railroad has just received from the Schenectady works of the American Locomotive Company five 10-wheel passenger locomotives, which are the most powerful locomotives of this type ever built for passenger service. They have a tractive power of 35,100 lbs., 22½ by 26-in. cylinders, a total weight of 201,000 lbs., and carry a boiler pressure of 215 lbs. The driving wheels are 69 ins. in diameter, and, although rather small for a 10-wheel passenger engine, are large for a locomotive of this type with a broad firebox. The driving wheels are the same size as those used on the 4—4—0 type engines on this road. This is the heaviest passenger engine of this type, being 2,000 lbs. heavier than similar engines built for the Lehigh Valley Railroad, which have a tractive power of 31,380 lbs., 21 x 28-in. cylinders, 68½-in. driving wheels, a total weight of 199,200 lbs., weight on drivers 150,200 lbs., and carry 205 lbs. steam pressure.

The only passenger engines more powerful than these, of which we have a record, are the 22 x 28-in. Pacific type locomotives built for the Southern Railway, which have a tractive power of 35,194 lbs., a total weight of 218,950 lbs., weight on drivers 141,650 lbs., 72-in. drivers, and carry 220 lbs. of steam.

The Prairie type locomotives used for freight and passenger service on the Chicago, Burlington & Quincy Railroad, described on page 78 of our March, 1905, issue, have a tractive power of 35,050 lbs., or a little less than that of the Lackawanna engines. Considering the tractive power, the total weight of the Lackawanna engine is remarkable low. The leading dimensions are as follows:

4—6—0 TYPE PASSENGER LOCOMOTIVE, DELAWARE, LACKAWANA & WESTERN RAILROAD.

GENERAL DATA.	
Gauge	4 ft, 8½ ins.
Service	Passenger
Fuel	Fine Anthracite
Tractive Power	35,100 lbs.
Weight in working order	201,000 lbs.
Weight on drivers	154,000 lbs.
Weight on leading truck	47,000 lbs.
Weight of engine and tender in working order	321,000 lbs.
Wheel base, driving	14 ft., 4 in.
Wheel base, total	25 ft. 6 ins.
Wheel base, engine and tender	54 ft. ¼ in.
RATIOS.	
Tractive weight ÷ tractive effort	4.38
Tractive effort x diam. drivers ÷ heating surface	717.
Heating surface ÷ grate area	35.6
Total weight ÷ tractive effort	5.72
CYLINDERS.	
Kind	Simple
Diameter and stroke	22½ ins. x 26 ins.
Piston rod, diameter	4 ins.
VALVES.	
Kind	Allen Richardson balanced
Greatest travel	5½ ins.
Steam lap	1 in.
Setting 1-16 in. lead in full gear forward and shift backup eccentrics to give ¼ in. lead at 6 ins. cut-off, forward motion.	
WHEELS.	
Driving, diameter over tires	69 ins.
Driving, thickness of tires	3½ ins.
Driving journals, main, diameter and length	10 x 13 ins.
Driving journals, others, diameter and length	9½ x 13 ins.
Engine truck wheels, diameter	33 ins.
Engine truck, journals	6½ x 12 ins.
BOILER.	
Style	Straight top
Working pressure	215 lbs.
Outside diameter of first ring	74⅝ ins.
Firebox, length and width	126⅛ ins. x 108¼ ins.
Firebox plates, thickness	⅜ and ⅝ ins.
Firebox, water space	4 ins.
Tubes, number and outside diameter	398 2-in.
Tubes, gauge and length	12, 15 ft. 3 ins.
Heating surface, tubes	3,156.3 sq. ft.
Heating surface, firebox	221.7 sq. ft.
Heating surface, total	3,378.0 sq. ft.
Grate area	94.8 sq. ft.
Exhaust pipe—Double nozzles	3½ and 3⅝ ins.
Smokestack, diameter	18 ins.
Smokestack, height above rail	15 ft. 9-16 in.
Centre of boiler above rail	116½ ins.
TENDER.	
Tank	U shaped with hood at front, D., L. & W. std.
Frame	10-in. channels and plates
Weight, loaded	120,000 lbs.
Wheels, diameter	33 ins.
Journals, diameter and length	5 x 9 ins.
Water capacity	6,000 gals.
Coal capacity	10 tons



10-WHEEL (4—6—0 TYPE) PASSENGER LOCOMOTIVE—DELAWARE, LACKAWANNA & WESTERN RAILROAD.

SHOP COSTS.—Another advantage to be gained by close knowledge of shop costs is this—it enables the foreman to intelligently ask for improved facilities. All general officers are willing to indorse requests for appropriations provided a saving can be shown equal to an amount representing a fair return on the investment.—*Mr. J. H. Wynne, before the Western Railway Club.*

CARE OF SANDERS.—Taking into consideration the small percentage of trouble caused by sanders, we are forced to the conclusion that if pipe joints are maintained and the sand properly prepared, always being dried thoroughly, screened and kept clean, the sanders now in use will give satisfaction. If this is done, it is safe to say that the efficiency of sanders will be increased 50 per cent., and an improvement of 50 per cent. in the performance of sanders, as compared to the present service, would be sufficient to please the most critical.—*Traveling Engineers' Association.*

(Established 1832).

AMERICAN ENGINEER AND RAILROAD JOURNAL

PUBLISHED MONTHLY

BY

R. M. VAN ARSDALE.

J. S. BONSALL,
Business Manager.

140 NASSAU STREET, NEW YORK.

R. V. WRIGHT, Editor.

NOVEMBER, 1905.

Subscription.—*$2.00 a year for the United States and Canada; $2.50 a year to Foreign Countries embraced in the Universal Postal Union.*
Remit by Express Money Order, Draft or Post Office Order.
Subscription for this paper will be received and copies kept for sale by the Post Office News Co., 217 Dearborn St., Chicago, Ill.
Damrell & Upham, 283 Washington St., Boston, Mass.
Philip Roeder, 307 North Fourth St., St. Louis, Mo.
R. S. Davis & Co., 346 Fifth Ave., Pittsburgh, Pa.
Century News Co., 6 Third St. S., Minneapolis, Minn.
Sampson Low, Marston & Co., Limited, St. Dunstan's House, Fetter Lane, E. C., London, England.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

To Subscribers.—*The* AMERICAN ENGINEER AND RAILROAD JOURNAL *is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied.*
When a subscriber changes his address *he ought to notify this office at once, so that the paper may be sent to the proper destination.*

If a man has become a machine because of the constant repetition of the same work over and over again, it is because his treatment has been mechanical and he has been brought up by machine methods. It is possible to surround labor involving the greatest drudgery with conditions which make life worth living, and if a man becomes mentally and physically a machine it is some one's fault. If your men are mere machines, there is something wrong with the method, and the men themselves are not to blame. Perhaps the trouble is "higher up."

A motive power officer was recently criticized because of the character of a great increase in the number of train delays. The matter became serious and in self-defense he sent several young men to keep tab on the trains leading to the most serious complaints. After satisfying himself the superintendent of motive power requested the transportation department to furnish representatives to act with the motive power representatives and jointly take a record of the trains. This revealed the fact that 17 per cent. of the delayed time was agreed upon as being due to the motive power department and 83 per cent. to others. By looking after such matters as the station stops, this trouble was straightened out. It seems strange that such criticism can arise. It could not if the departments really endeavor to help each other.

In connection with the introduction of a device for aiding locomotive firemen, a study of the work of these men shows that for each ton of coal fired approximately 600 distinct movements are required of the firemen, divided as follows: 1. Filling the shovel with coal. 2. Opening the door. 3. Picking up the shovel. 4. Throwing the coal into the firebox, and 5th, Closing the door. These movements are represented for every shovel full of coal, and the analysis throws a strong light upon the work of the firemen, indicating the reason why brute strength is a necessity to these men. With a device which opens the fire door automatically, due to the operation of a valve by the firemen's foot, the number of movements for a ton of coal are reduced to 234. Assuming that ten tons of coal are fired upon the trip, with a No. 4 scoop, holding on an average 17 lbs. of coal, a fireman ordinarily makes 6,020 movements. With a device which opens the door 2,340 movements are required, which is a reduction of 3,680 in the handling of ten tons. In a long freight run, requiring the consumption of 20 tons of coal, the fireman's movements ordinarily aggregate 11,700, of which 7,020 may be eliminated by the employment of the device.

MALLET COMPOUNDS FOR ROAD SERVICE.

Thus far the Mallet type does not seem to have been seriously considered in this country, except for helper service on very heavy grades. It is certainly worth while to consider the possibilities of this type for heavy main-line freight service. Some of the advantages offered may be enumerated as follows:

(1) Economy in fuel; (2) all weight available for traction; (3) large tractive power; (4) superior ability in starting heavy trains; (5) even pull on draft gear; (6) avoidance of severe jerks in starting in case of slipping; (7) division of work among an increased number of parts.

These classifications, as shown in experience with the large Baltimore & Ohio Mallet compound, seem to justify high expectations from this type in heavy road service.

LOCOMOTIVE EQUIPMENTS.

The importance of systematically looking after tools and equipment on locomotives may be judged by a statement made in an article on this subject on another page of this journal. A road with something over a thousand locomotives spent $70,000 per year to maintain this equipment. Each engine was supposed to carry an equipment valued at $65, but in spite of this large expenditure, on an average only $20 worth of equipment could be found on any one engine, because of the lack of system and proper care. Such a condition must necessarily be responsible for many delays and inconveniences to traffic because of the proper tool being absent when most needed. The article in question should be studied carefully, and it is valuable because it not only considers the tool equipment on an engine, but tells exactly how to look after it systematically in order to obtain the best results. It is the more valuable because it comes from one who has had considerable experience in this work and is in a position to speak authoritatively.

THE VALUE OF A SMILE.

A certain man who is very successful as a manager of men and one who has brought order out of chaos in a relatively short time is one who while seriously minded wears a pleasant expression and is always ready to smile. He is working under extraordinary difficulties, and whatever expression his face may wear when the day is over and he is out of sight of the shop and of the men he never allows the men to be discouraged while he is about the work, but supports and enthuses them by his confident appearance. This officer says to his foreman "You must look cheerful no matter what you may be up against."

What would become of an army undertaking a difficult manœuvre in the face of the enemy if the superior officers were glum and discouraged? How will the privates in the ranks feel if they see that their officers are doubtful and afraid? Look pleasant, it will give your men confidence and they will help you because of your own confidence and their confidence in you. The gentleman referred to has on his desk the rather common reminder: "Do It Now," but has added to

it the words, "And Smile." If the readers know who is referred to let them watch the result in his progress.

MILLING CAST IRON AND CAST STEEL.

For a considerable time we have advocated a more extensive use of milling machines in railroad shops. In one shop, recently visited, the shop superintendent strongly scored the slab miller, but investigation showed that he had a machine which was over twenty years old and not at all adapted to modern machine shop practice, and it was no wonder he was disgusted with it. Other shop superintendents are enthusiastic concerning the milling of mild steel, wrought iron or bronze parts, but are skeptical as to the advisability of milling castings, because of the effect on an expensive milling cutter of the hard scale and sand. A visit to the shops of the machine tool builders reveals the fact that they are using these machines to considerable advantage in milling castings; it has been suggested, however, that possibly these castings are of a better grade of cast iron than ordinarily furnished the railroad companies, and possibly there is some truth in this. It is interesting to note that several railroad shops are milling certain of their castings, or are experimenting along this line. On another page of this journal is an interesting article on the milling of cast iron and cast steel driving boxes at the Angus shops, and it would appear that such work can be handled very successfully if the cutters are properly designed and taken care of. It is, of course, necessary to determine the speeds and feeds at which the cutters can be operated to get the best results, and with cast steel it is important to furnish a plentiful supply of lubricant to the cutter. In order to gain successful results it is also necessary that the machines be of heavy and rigid construction, so that there will be practically no vibration. The milling cutters should be of high-speed steel of the inserted type. It is surprising how easy it is to keep these sharp and in good condition if the proper facilities are provided for grinding.

ROCK ISLAND LOCOMOTIVE REPAIR SHOPS.

The building of these shops is a good illustration of "Western push." Judging from the remarkably short time in which they were planned and the buildings erected, we might expect to find that they were incomplete or else closely modeled after some existing plant. It is rather surprising to find, on the contrary, that they are strictly up-to-date in all respects and that many new and radical features have been added, which makes it possible to handle the work quickly and economically. In the article which appears on these shops in this issue, which is the first of a series, the arrangement and construction of the buildings is described. The most noticeable features about the buildings are the splendid daylighting, simple construction and the duplication of detail design, thus reducing not only the first cost of the buildings, but also the cost of maintenance.

Another feature, which is to be commended, is the arrangement of the large locomotive shop with the erecting department in the middle and the machine and boiler departments on either side with no walls between them. In case one department becomes crowded, it is very easy to extend it over into one of the other departments. In designing a large shop of this kind, it is difficult to determine how much space should be devoted to each department, and, as the locomotive designs change, or as the motive power becomes older, or as the amount of manufacturing for other points on the road increases, one department is quite liable to become overcrowded, and it is therefore wise to arrange these three departments so that their limits may readily be changed to suit new conditions. As practically no restrictions were placed on the arrangement of the buildings, the layout plan may be considered as an ideal one for the conditions for which it was intended and is worthy of careful study. It will be noted that generous allowances have been made for future extensions to all of the shops.

THE COST OF LOCOMOTIVE REPAIRS PER 1000-TON MILES.

BY HARRINGTON EMERSON.

There ought to be a normal relation between 1,000-ton miles and locomotive repairs, or between miles run and repairs. There is not. Each railroad makes up averages, but what is the value of averages except for life insurance? What is the normal cost of repairs per miles run when in a given case out of 144 shopped engines, none wrecked, 36 averaged \$0.17 per mile between shoppings and other 36 averaged \$0.0287 per mile? Of the first 36, 6 averaged per mile \$0.53 and of the second 36, 6 averaged \$0.0128 per mile.

Here again we have averages, but there is no average in the fact that a certain engine cost per mile \$0.0073, and another engine \$0.50 or 70 times as much. What deduction is to be drawn when the engine costing per mile \$0.0073 weighed 210,000 lbs. exclusive of tender and the engine costing \$0.50 per mile weighed 99,500 lbs. exclusive of tender? Evidently none of any value. It is much more important to find out why the repairs on one engine cost 70 times as much as the repairs on another engine per mile than it is to speculate as to whether the repairs on light engines cost more per 1,000-ton miles than the repairs on heavy engines. An opinion may be ventured, even an assertion made, that in a shop employing best modern methods the repairs per 1,000-ton miles on a modern monster will cost less than the repairs formerly cost per 1,000-ton miles on the old style small engines of fifteen years ago. For this assertion, convincing proof is lacking chiefly because there are few railroad shops, one might say none, in which the best modern methods are employed. A modern shop is one which knows what it is about unto minutest details both as to why and how, and acts accordingly; not a shop with a large array of expensive modern tools and Egyptian darkness as to causes and results.

Even if the assertion were proved, even if big engines could be maintained more cheaply per 1,000-ton miles than small engines formerly were, the battle as to shop costs between big engines and small engines is not solved, since perhaps the old engine in the shop with modern methods might far surpass in lessened cost of maintenance not only its own type in the long ago shop but its big rival in the same shop. The fact remains that as yet locomotive repair costs cannot be wholesaled by weight alone. There are identical big locomotives that are very, very cheap to maintain and there are others that are very costly and the same variation occurs among the smaller locomotives.

To date we cannot safely generalize. Railroads are peculiar not to say funny. If they were elevated or surface lines levying a flat rate of fare, one could understand their flat methods of running their shops and averaging engine repairs. But in their revenue they are most particular to go into details. No zone system for them with unit rates, good between any two stations. Each passenger has to buy a ticket for just the distance he intends to travel, no more or no less, he must use it on the day purchased and be checked up when he enters the train, when he leaves it and several times between, so fastidiously careful are the railroads to be certain that they obtain all that is coming to them. When it comes, however, to spending the money laboriously collected from the grumbling public all methods of precaution are overlooked. Engines are butchered out on the road and are cobbled in the shops and both the butchering and the cobbling are averaged.

The speed of trains and the speed of individual engines has been tested close up to the limit, but is there a single engine in America of which we can definitely say that its repairs have cost a minimum even for that engine, much less the minimum per 1,000-ton miles of all engines. Until facts are available to give this information not only about one engine but about all engines, we are a long way from being able to pro-

nounce as to the relative value of engine types and performances. Such facts are theoretically easy and practically hard to obtain and yet if followed up they are more profitable than any Yukon gold mine. They are theoretically easy because they require neither expensive accounting nor exasperating detail tabulations. They are practically hard because very few have faith in their value and they are not available from the way railroad accounts have been hitherto kept. On the same railroad in neighboring shops I have found such a standard operation as flue welding and tipping to be done at the rate of 12 an hour, 25 an hour, 40 an hour and 100 an hour. The same disparity exists in other normal operations. The way to cheapen engine repairs is not to build new shops and equip them with heavy modern machinery, but to keep detail account with every single engine and tabulate not only every deficiency that develops in service, but also standardize every shop operation and practice and establish its normal cost.

The first road that systematically and intelligently follows this course will take a long step towards bringing down all its engine repairs to a phenomenally low normal, and in its accounts we shall no longer find variations of 70-fold in repair cost per mile run.

COMMUNICATIONS.

A GOOD SUGGESTION CONCERNING COMPOUND LOCOMOTIVES.

To the Editor:

The brief editorial on the failure of the compound locomotive, which appeared in the September issue, calls to mind a conversation which I had—more than two years ago—with an engineman on a road where the compound was, at that time, extensively used in freight service. I was riding in the cab, and noticed, after we were well started, that he continued working the engine single expansion. On asking him about it he informed me that the starting valve was usually left open. I endeavored to explain the advantages of compound working and the use of the valve; he appeared interested, and finally said: "All right, you can close it," and during the remainder of the run, the valve was always closed after the train was started.

It seems to me it is a mistake to tell a man to do a certain thing without telling him *why* he is to do it. He may be informed that the starting valve is to be closed after a certain rate of speed has been attained, but unless he understands why that is desirable he is liable to lose interest and forget all about the matter. It may require time and trouble to give such an explanation, but without doubt it would, in many cases, prove a paying investment in the end.

COMPOUND.

WALSCHAERT VALVE GEAR.

To the Editor:

Having read the numerous articles which have appeared in the AMERICAN ENGINEER AND RAILROAD JOURNAL, relative to the advantages and disadvantages of the Walschaert valve gear as applied to locomotives, I notice that there is a great deal of discussion on the distribution of steam obtained from it, due to constant lead at all points of cut-off. One of the points being discussed very much is that on account of the amount of lead used with the Walschaert gear, when the engine is working at full stroke the pre-admission will have a bad effect when trying to start a heavy train, and for that reason it is considered a very strong argument against the Walschaert valve gear. I am of the opinion that this is of very little detriment to a locomotive; for instance, take a locomotive with the Walschaert valve gear having a 3-16 in. lead and cutting off at full stroke the pre-admission is about 3-32 of an inch. If you stop to think of the position of the crank pin at this time, it will be seen that there will be very little retarding effect upon the engine from this source, and as an engine is working at full stroke, or nearly so, at a very small percentage of the time, I cannot but see that the advantage is with the Walshaert gear in this respect, on account of decreasing the pre-admission when the engine is working at short cut-off; for instance, an engine with 3-16 in. lead working at 6-in. cut-off the pre-admission is about ½ in., whereas with the same engine equipped with the Stevenson link motion, the engine would in all probabilities be set ¼ in. to 9-32 in. lead at 6-in. cut-off. With this lead the pre-admission would be about ⅞ of an inch, and it is when the pre-admission is as great as this that the retarding effect upon a locomotive is considerable when being crowded to a high rate of speed.

A great many try to cut down the compression in the cylinders by giving the valve more exhaust clearance. My belief is that very little, if any, lead is required on a locomotive either at short or long cut-off, and would recommend decreasing the retarding effect due to compression and pre-admission by cutting down the lead at short cut-offs. The Walschaert valve gear offers a splendid opportunity for this because you can set the Walschaert gear engines line and line or 1-16 in. lead at all cut-offs, and an engine with this amount of lead both at full stroke and at short cut-offs will start a train just as quickly and run faster than an engine which is set line and line or 1-16 in. lead full cut-off, but when hooked up to short cut-off the lead is increased to ¼ or 5-16 in. The Walschaert valve gear on locomotives is the coming gear. Its advantages over the Stevenson link are many, and its disadvantages very few and of very small value.

Cleveland, Ohio. J. T. CARROLL.

WALSCHAERT VALVE GEAR.

To the Editor:

In the communication from Mr. C. H. Quereau on Walschaert valve gear, published in your September journal he infers a condition which the writer has found does not exist, at least on an engine recently fitted with this valve gear on the Lake Shore and Michigan Southern at Elkhart, Ind. On page 317, Mr. Quereau states that when working in full gear, steam will be admitted to the cylinder when the piston is about 2 ins. from the end of the stroke.

We find that on the engine referred to, this pre-admission is practically nothing at full stroke, the valve beginning to open when the piston is 3-32 of an inch from the end of its stroke. Practically this same condition exists on the New York Central engine equipped with this valve gear, of which valve motion cards are given on page 214 in the June number of the AMERICAN ENGINEER, in which the pre-admission is shown as being zero, although it is hardly possible that the valve should move to the amount of the lead at the beginning of the stroke without the piston moving, at least, a measurable amount at the same time. With this slight amount of pre-admission it seems to the writer that Mr. Quereau's claim of excessive strains due to it, is hardly justifiable. The pre-admission increases as the cut-off becomes shorter, although the lead remains constant, and thus just those conditions prevail which Mr. Quereau (and the writer) seems to think desirable, namely a longer time for the steam to enter the cylinder at the higher speeds.

OSCAR ANTZ.

THE RAILROADS AND LOCOMOTIVE DESIGN.

To the Editor:

Your recent article on broken frames leads to the question, "Are the designs and types of locomotives which the builders bring out with such commendable enterprise sufficiently studied by those having charge of the operation and repairs of the machines?" Written reports of breakages, cracks, or excessive wear discovered in any part of the locomotive or tender on the road, in the engine-house, or in the shop, also of poor steam performance, would, if thoroughly studied and investigated, result in an improvement in American motive power, the faulty condition of which is forcing itself upon the attention of the travelling and investing public. The mere addition of metal to a fractured section may usually be construed as a failure to comprehend the real cause of the trouble, for a change in the location of a bolt or a rib, the obviation of eccentric loads and bending, an increased rigidity or flexibility, near, or at a distance from, the break, will often accomplish what no mere amount of metal can. A common mistake consists in placing a plain rib on the tension side of an iron casting. Such a rib is often a source of weakness rather than strength.

Besides lateral vibration and slack in driving-boxes, connecting rods, and tender buffers, unnecessary bending moments will be found to be frequent causes of frame breakages. For example, many 4-6-0 engines have the forward equalizer fulcrums bolted to slender, lower frame rails, with the only struts between the upper and lower rails located at some distance ahead. The rails usually break at their back ends. Another example is furnished by

many recent 4-4-0 engines having no strut from the frame to the boiler between the guide yoke plate and the firebox. The supporting force from the front hanger of the forward driving spring produces a beam action in the frame, and breakages are frequent, especially if a poor type of pedestal binder is used. A strut plate from the frame to the boiler over this pair of spring hangers will do away with the bending and will also prevent lateral vibration. The high, flexible guide-yoke plates now in use might safely be bolted to the boiler, relieving the frame of part of the crosshead load applied at every stroke while the engine is backing. In the older designs the vertical forces were more effectually arranged for the balancing of each by one in line with it.

It is but a simple algebraic operation to determine the correct lengths of spring hangers and proportions of springs; and there is no necessity for equalizers to stand at angles of five to ten degrees or for engine and tender chafing irons to be five or six inches out of line.

Some improvement might be effected in boilers by the erection of simple apparatus for measuring the distortion when test pressures are applied, and comparing it with the form of staying and the records of repairs. A boiler with radial stays arranged approximately as described in your correspondence columns of February, 1901, has now been in service aboout two years, and in that time has but once required to have its fire drawn on account of a firebox defect, and that was for a sllght leak in one tube.

G. E.

FLEXIBLE STAYBOLTS.

To the Editor:

I have read with much interest the article in your September paper, entitled "Methods of Installing Flexible Staybolts," which leads me to bring up several points stated therein for discussion. Yes, I agree with the author: it is vitally important to the success of the flexible stay that good work always be done in the installation of the complete bolt. And yet, how can we reconcile this statement with the one made further on in the article, viz.: that the cost of installation should not exceed 25 cents per bolt and, when installed in large quantities, should be as low as 15 cents per bolt? All of us who have worked or closely observed conditions in modern locomotive repair shops know that good work cannot be obtained at the figures named by Mr. Stafford. I would be much more inclined to put the installation cost at from 30 cents to 40 cents per bolt, or, in large quantities, at 25 cents per bolt. I suppose the author, when he gives such low figures for large quantities, takes it for granted that a large installation would only be made when a locomotive came in for general repairs, in which case special care could be taken to charge a large percentage of this cost to one or more of the many other items of expense. This is all right for the staybolt's reputation as a money saver, but does it represent the true facts of the case?

The first essential demand of any appliance, where possible, both from a mechanical and a financial standpoint, is simplicity in design and construction; mechanical to eliminate blunders and poor installation by careless workmen, and financial to save on the expense of first cost of installation and maintenance. Now, it seems to me, after a careful perusal of Mr. Stafford's article, that a staybolt, the life of which depends to a great measure upon the many and costly operations as laid down by him, should be entirely eliminated from boiler practice as wholly uneconomical from every point of view. Uneconomical, because we get no visible return on our high first cost in the longer life of the so-called "flexible" over the ordinary "rigid" stay.

I would also like to differ with Mr. Stafford that staybolt breakages have in no sense diminished, regardless of the quality of iron used. Would say, in reply to this, that the highest grade of piled iron, such as is used altogether by the Falls Hollow Staybolt Company, makes a truly flexible bolt. Their claim to flexibility in its truest sense is backed up by all motive power officials who have any knowledge of mechanics or metallurgy and by those who have not this knowledge from the practical results that they have obtained in its use. Whatever claim the so-called flexible stay has to flexibility, it must relinquish when it comes in contact with hard water, for it has been found, from general practice, that the sediment and incrustation thrown down by hard waters does not spare the aperture surrounding the outside head of the bolt any more than it does the flues or any other part of the heating surface, and, as soon as this aperture gets filled with a deposit or incrustation of sediment, we have the simplest kind of a rigid bolt. But what a price to pay for an ordinary rigid stay!!

In summing up, we can best describe this so-called "flexible" stay by quoting from a paper read before the New York Railroad Club by Mr. Livingstone, the best expert on staybolt material and practice in this and any other country, when he says that the kindest thing that can be said of the "flexible" stay is that they sometimes use the best quality of piled staybolt iron in their manufacture. There are many other points open to discussion in this article, and I would greatly enjoy seeing them threshed out in the columns of your paper.

Very truly yours,

F. C. LIPPERT, M.E.

THE DESIGN OF BRAKES.

To the Editor:

Will you kindly allow me to submit the following method of designing brake heads and hangers? While the example selected is for inside-hung brakes on eight-wheel cars, the modifications necessary to apply the principles to other cases are obvious.

Let A = weight on each wheel.
B = percentage braking "power."
C = coefficient of friction.
D = height of center plate bearing above rail.
E = wheel base of truck.
F = factor explained below.
G = angle whose tangent is C.

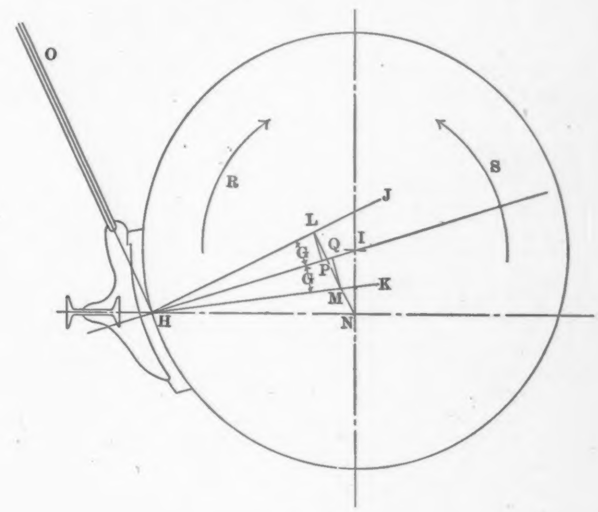


FIG. 1.

Draw HI (Fig. 1) from the center of the brake shoe through the center of the wheel, and draw HJ and HK, making angles IHJ and IHK equal to G. Lay off HL to some scale to represent $AB\left(1 - \frac{2\ BCDF}{E}\right)$ and HM to represent $AB\left(1 + \frac{2\ BCDF}{E}\right)$. Draw a horizontal line through H, and draw LM, extending it to intersect the horizontal line at N. Through H draw HO parallel to LN. Now HO will be the center line of the hanger and HN the center line of the brake beam. The hanger may be attached to the head anywhere in the line HO and the lever may be attached to the beam anywhere in the line HN. Draw LP and MQ perpendicular to HI. When the wheel is going in the direction R, HN is half the pull to be exerted by the lever on the beam, MN will be the stress in the hanger, HQ will be the resultant normal pressure of the shoe against the wheel (it should be noticed that it is applied at the center of the shoe), and QM is the retarding force due to the friction of the shoe on the wheel. The stress in the hanger and the pull of the lever, combine to give a resultant HM, which is decomposed into a normal pressure HQ and a tangential resistance QM. Similarly, when the wheel is turning in the direction S, HN is half the pull of the lever, LN is the tension in the hanger, HP is the resultant normal pressure of the shoe, and LP is the retarding force. The brake head may now be laid out, making thickness of shoe equal to that when the shoe is a little less than half-worn out. The diameter of the wheel should be the average to be expected during the life of the wheel, and the hanger should be as long as convenient.

It will be found that wide variations in the coefficient of fric-

tion will make but a slight difference in the direction of the hanger. The factor F. however, will make considerable difference. It can vary between 0 and 0.85 or 0.90. If the truck is light compared with the weight of the car body, if the brake gear is to be kept in first-class repair so that there will be no danger of cramping the hanger, if the variations in diameter of wheel and thickness of shoes are small, and if it is desired to obtain the highest possible braking force without danger of sliding the wheel, a high value of F should be selected. Otherwise F may be reduced according to judgment. When F is 0, the hanger is perpendicular to HI, and the braking forces on the forward and back wheels are equal, the greatest possible advantage of inside-hung brakes being thereby destroyed.

The above rule, gives, to the greatest possible extent, an arrangement which insures even wear of the shoes and a maximum possible braking "power" without sliding the wheels. The head may be rigidly fixed on the beam, with no detriment to its action. A third hanger at the end of the brake beam fork is advisable to steady the beam and to be sure that the shoes do not drag when released. It should be of the same length as the brake-head hangers, and should be parallel with them, but it need not be at the same height. Such hangers can, to a limited extent, overcome defects in the design, but it is not wise to impose more upon them than is necessary.

Since the forces exerted by the rods upon the levers are horizontal, it follows that the levers must exert horizontal forces on the beams. The beam should, then, be horizontal. Inclining it merely changes the height of the lever, as far as the action of the shoe on the wheel is concerned. It places the lever in an awkward position for connecting it to the rods, sets up stresses in the third hanger, and produces the torsion in the beam which has been so prolific a source of failures of beams by starting the buckling.

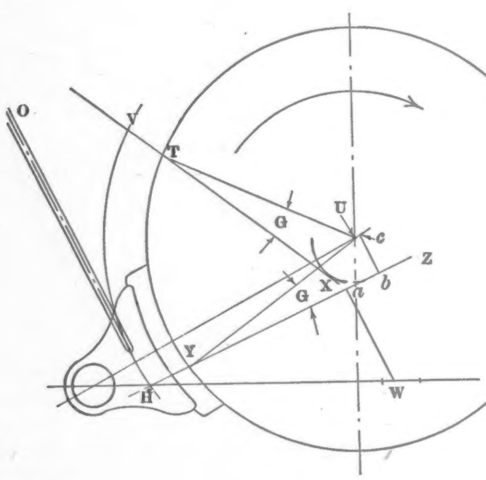


FIG. 2.

The action of an existing arrangement can be studied as shown in Fig. 2. The center line of the hanger and the horizontal line through the beam, intersect at H. Lay off WH to represent half the pull of the lever. Draw any radius TU, and draw TX, making angle G with it. Extend TX to meet, at V, an arc drawn through H with U as a center. Transfer lines TU and VX to YU and HZ. Draw Wa parallel to HO. Wa is then the tension in the hanger, and Ha is the force exerted by the shoe on the wheel. This is transferred to Yb and decomposed into Yc and bc, Yc is the resultant normal pressure when the wheel is turning in the direction of the arrow. It is applied far from the center of the shoe. The pressure at any part of the shoe can be determined by the well-known method of eccentric loads. In this case the intensity of pressure after the shoe has become well fitted to the wheel, will be about 0 at the top, and at the bottom it will be about twice as much as it would be if evenly distributed. The procedure for a rotation of the wheel in the opposite direction will be the same except that angle G is laid off on the other side of line TU. In this example, the action would be slightly better, but the pressure would still be greatest at the bottom. Unless, then, the third hanger exerts great force to hold the brake beam fork down, the shoe will wear almost entirely at the bottom.

The correctness and convenience of the above theory are evident. As is to be expected, practical experience checks the results.

G. E.

ENGINE EQUIPMENTS.

BY H. EMERSON.

The railroad is the skeleton of our civilization; locomotives are the muscles; whatever pertains to the operative efficiency and economy of the locomotive is of interest. This subject of engine equipments is of much interest, for upon the equipment, and its care and use, depends largely the efficiency of locomotive service and often the economy of time and property.

Engine equipments are made up of such items as are included in the following list:

APPURTENANCES.

Grease cups: rods, guides.
Flags: red, white, green, blue, yellow.
  Flag holders or brackets.
  Flag boxes.
Headlight: front, rear.
Lanterns: red, white, green, blue globes.
Lamps: blizzard or classification marker.
  Slides: red, white, green, blue.
  Lamp brackets: front end, pilot, rear tender sides, rear tender center.
Cab lamps: steam gauge, water glass, air gauge, steam heat gauge.
  Brackets for same.
  Guard for water gauge glass.
Boxes: seat, tender.
Fire door chains.
Coal boards: front, side, back.
Push poles or stakes.
Torches.
Cab curtains: back, sides.
Seat box cushions.
Hooks: for clothes, for keys.
Arm rests.
Gauge cock drip trough.
Tank ropes.
Electric cab block signals.

APPLIANCES.

Coal scoops.
Oil cans: engine, valve, headlight and signal. Oil supply cans.
  Engine and valve oil oilers, long spout, short spout, squirt can.
  Dope pails, tallow pots and covers, grease cup charges.
Fire tools: single or double hook, slice or slash bar, shaker bar, coal pick, hoes long and short, pokers for firebox and for front end.

TOOLS.

Hammers: hard hand, sledge, combination, soft.
Wrenches: Monkey or screw, Stillson or pipe, alligator, double-end set-screw, double-end eccentric set screw, double-end wedge bolt, double-end oil cup, double-end rod, air pump spanner, lubricator spanner, injector spanner, injector knuckle, main rod wrench, crank-pin nut wrench.
Chisels: flat, long cold, cape, round nose, bars.
Sets, punches, files, drifts, scrapers.

SUPPLIES.

Headlight chimneys: glass, mica.
Water glasses, gaskets.
Lubricator glasses, gaskets.
Hose: airbrake, dummy brake, air signal, dummy signal, steam, all couplings (including heater to water scoop), gaskets.
Lamp wicks, wicking.
Waste.
Bell cord.
Brasses, engine truck, tender truck.
Bolts and nuts.
Rod keys.

EMERGENCY.

Replacers or wrecking frogs.
Chain and hook, wrecking or switch.
Jacks: large and journal box, jack levers.
Pinch bars.
Fusees and torpedoes.
Guide blocks.
Main crank pin blocks.
Valve stem clamps.
Medical boxes.
Plugs for cylinder release valve.
Emergency knuckle.
Ax and saw.

MISCELLANEOUS.

Water buckets, brooms, brushes, sponges, sponging irons, water coolers or kegs, drinking cups, tripoli can, time card holder, fuel books, stores books, time slips, framed instructions, lubricator, electric headlight, tool list, seal for tool box, lock for same, portable tool boxes.

This list is not comprehensive; it is only representative of actual practice here and there.

How should the engine equipment, made up of such items, be handled? Shall we deal with engines as individuals, or with engine crews? Shall we "standardize" equipment, making it of general uniformity for all engines, all enginemen, all conditions, or shall we vary the equipment to suit each case? Shall our aim be to have the smallest practicable equipment, or shall we make traveling store-houses of our engines in the endeavor to provide for every chance? And, in the end, shall or shall not economy of supplies and supervision be the determining watchword?

Of course, every operating locomotive in the land carries some equipment—else it could not run. Also, most of our larger roads have made some endeavor to systematize this

problem—as is evidenced by printed tool checking lists, and occasional roundhouse tool inspectors: and in one way or another the crews get supplied. But, generally, this detail of railroad operation is overlooked or neglected by the higher officials (general manager and superintendent of motive power), who alone can bring about any lasting good in the matter. At the outset, therefore, if anything is to be accomplished along this line, it must be done on a large scale, on a thorough scale; and in the doing, money (tens of thousands), time (months—a year), must be spent. This once done, actual annual savings in stores and in expense should surely result, with also much greater satisfaction and efficiency of the service.

HOW TO IMPROVE CONDITIONS.

To be most completely worked out, the matter should be in the hands of the superintendent of motive power, who might, however, call in to advantage an advisory committee of, say: mechanical engineer; a master mechanic or roundhouse foreman (usually too busy!); a superintendent; a storekeeper (preferably a man intimately conversant with the conditions of issuing stores to engine crews, who should also in the present case familiarize himself with the annual accounts for the road respecting engine equipment supplies); an engineman (member of engineers' committee?) This committee could not meet as a whole very well oftener than once in a month, and each member could hardly do more than give some attention to the matters affecting his particular interests; its province would be advisory and debative—possibly in most cases decisive; the co-ordinating executive work should be wholly in the charge of someone specially delegated to the task, he to be responsible to the superintendent of motive power, and to consult fully with members of the committee individually, as well as in session. Representing the superintendent of motive power, this man's rank, while carrying out the organization and in respect to it, should be above that of the master mechanics; that is, he should have ample authority to put the work into effect; he might conveniently do this by using the superintendent of motive power's name rather than his own.

What state of affairs will this man (whom we may call equipment inspector), and this committee find? Locomotives running into the dozens of classes, each class having slightly different requirements in equipment (i.e. rod wrench sizes, water-glass lengths), even locomotives of a class often differing; requirements varying also with different kinds of service (freight, passenger, switch), on main line and on branches, on different divisions; pooled engines will be devoid of almost all equipment—what remains being left only because unfit to take away!—assigned engines, on the other hand, having tool-boxes fairly bursting with the greatest assortment of miscellaneous wrenches, fixings, etc.; some engineers (and especially firemen) will be hostile to any attempt at systematization, the more so where responsibility is involved; the roundhouse forces will be too busy to heed anything; and it will be found that the stores on different divisions carry articles for equipment varying in style or quality, that some things are manufactured in shops when they might be bought better and cheaper, or the reverse, that many articles are not the best or most serviceable or suitable (i.e. gauge lamps, or spring valve long oilers), that some things are carried uselessly while other items are lacking though needed, that the printed list is probably perfunctory and doesn't agree with the actual stock or with sundry circular letters of instruction. In other words the whole problem will be vexatious, inconsistent, confusing—apparently hopeless!

The committee named is a very broadly representative one, and not without reason, because this little subject has many deep ramifications. For instance, it is desired to "standardize" all the tool and seat boxes and lockers. Of course, this can be done only after the equipment has been decided upon, so that these boxes may conveniently contain each its proper outfit. It is at once found that the tenders are of all different classes and arrangements, and that it is almost impossible to get any "uniformly standard" method of placing boxes. The best that can be done is to have one, or perhaps two, alternative plans. Similarly attempts to standardize coal boards (for cheapness of manufacture, and convenience of keeping in stock and applying) meet the same difficulties. Locomotive cabs, it will be found, are equally fractious in exacting varying widths, heights or lengths to the boxes put in them. In designing "standard" types of locomotives (such as the Harriman common standard; or the Rock Island standard types), the matter of cab and tender arrangement should be considered by the mechanical engineer, and provision made for using standard equipment.

Again, as fast as certain articles are recognized and adopted as "standard" equipment, a drawing and full description should be made of same, it is then definite, and may be referred to by number. This feature also comes under the mechanical engineer.

Some one suggests a uniform bracket for all classification or signal lights, on cars and cabooses as well as on engines and tenders—suggests furthermore a uniform style of lamp, adaptable instantly to either right or left, and, being composed of white (the cheapest) lenses, changeable by means of colored glass slides or tin blanks to any system of color signals desired. This proposition cannot be worked out without the advice and consent of your superintendent.

Before any actual organization is attempted, these matters of standard equipment, and the main plan of the checking and accounting system, should be determined upon, drawings made, quotations and samples asked of the purchasing agent, and orders placed (these orders should be quite aside from the regular monthly requisitions, until the equipment is in service—though of course, the requisitions should conform to the standard articles, a detail which your equipment inspector should very carefully watch out for, and correct, before the requisitions are sent up for approval). For it does not pay to try one thing, then switch over onto something else, and so add to the confusion at the very start. The preliminary preparation and development of this system may well take from 2 to 4 months or even 6; that is it may well be this length of time before a single tool is placed on an engine under the new arrangements. But it will be time of gathering information as to tender dimensions, sizes of valve-stems (in service—not on blue-prints), of crank pins, of crank pin nuts, of making inventory of equipment in service, of stock in the stores, of sizing up the facilities for applying equipment on various divisions, of selecting men and familiarizing them with the duties of such equipping, etc.

It will be well if the equipment inspector can spend two or three weeks investigating practice in the roundhouse, on the road, and in the office records, on other railroads. The New York Central, the New Haven, and the Pennsylvania are profitable (and extensive) fields for such study. The time thus spent will be a paying investment, as it insures the best precedents being followed.

ITEMS WHICH SHOULD BE STANDARDIZED.

The following items, if used at all, should each be reduced to one uniform standard over the whole railroad:

Headlights and chimneys, lubricators, air signal hose, air brake hose, passenger; air brake hose, freight; steam hose, all hose and couplings between engine and tender, signal lamps and brackets, gauge lamps and brackets, water glass lamps, bell cording, wrecking chain, pinch bars, fusees (10-minute), torpedoes, valve stem clamps, medical boxes, emergency knuckle, ax, saw, water buckets, brooms, brushes, sponges and irons, water coolers, drinking cups, tripoli can, card holder, portable tool boxes, flags (size and quality), lanterns, fire-door chains, push poles and method of carrying; torches, seat box cushions, hooks, gauge cock drip trough, the various sizes of oil cans, coal picks, hand hammers, combination hammers, soft hammers, each size of screw, Stillson and alligator wrench, each style of chisel, set, punch, file, drift or scraper.

COST OF INSTALLING NEW SYSTEM.

An engine equipment will cost from $20 to $150. A very satisfactory one should be obtained for $50 to $60. The total "life" of this equipment, under first rate management, is estimated at from two to five years; in actual practice, without adequate organization, the "life" is but a few months. I know of a case where the full equipment of an engine was worth $65 complete, excepting the headlight. There were over 1,000 engines on the road. No one of them was completely equipped; most of them had less than one-third of what they should have had. Yet the annual requisitions for engine supplies alone totaled much over $70,000 (it was not practicable to get at records of articles made in shops), or more than the complete cost of an equipment for each engine every year; and even then the engines did not carry more than $20 worth of stuff at one time! The figures should have been about $25,000 for supplies, to which might be added from $10,000 to $15,000 to cover the cost of the inspectors, the "organization." And then the engines should have had each the full $65 equipment, all the time.

For a road of this size it would take nearly a year to work the problem out, and in that year perhaps $50,000 would be spent for *new* equipments, in addition to the current $25,000 (or probably a little more than $25,000 until the organization was completed); and as much as $30,000 might also be spent on "labor" (or "intelligence") or men to place boxes and equipment on engines, make record of and check same. This totals over $100,000, for the first year. The second year is, we have seen, only $40,000. In other words in two years, spending the same amount that we were spending ($70,000) to secure an average $20 equipment on an engine, we could secure a full, efficient and *economical* organization, have every engine running with an entire complement of supplies, and thereafter, while maintaining the same high standard, secure a net saving of $30,000 per year. I speak not from theory but from fact, from experience.

Reducing this to terms of one locomotive (and the railroad official may multiply by the number of his locomotives to get the gross figures) this means that whereas an engine may be running (and the condition is nearly average) with nominally a $65, but actually a $20 equipment, at a yearly cost of $65 to $90 (taking into account engines in shop), under proper management, with an investment cost of $100 to $130 for the first year, the subsequent total annual cost will be only $40 to $50 per engine—a net saving of $25 to $40 each year on an extra investment for one year of $35 to $40.

Were similar results attempted on a smaller scale, over a longer period of time, no doubt commensurate results could be secured. But the slower the time, the smaller the scale, the longer deferred are the savings—the longer continued are the wastes.

I have not space at this time to discuss what should be an ideal equipment to fit average conditions, treating each item separately, together with dimensions, costs, material, etc.; nor can I go into an exposition of the printed forms, method of keeping records of each engine and crew, method of ascertaining daily just what equipment is drawn from store, by whom, and where; I can do no more than give a brief outline of the way in which the problem may be approached, and add thereto a few suggestions. I have already proposed placing the matter in the hands of the superintendent of motive power, the appointment of an advisory committee of some importance, and the delegation of the execution of the plan to an equipment inspector. This individual has studied the essential features of practice on other roads and has made his report to the committee; our committee has at length resolved upon the full standard equipment, the general plan of organization, the latitude to be allowed to the inspector in carrying out the plan; our committee has also made its recommendations to the superintendent of motive power, as to the scale on which it is advisable to plunge into the venture—the "first year" investment in complete equipments, the number and rates of men placed on the various divisions with the special (and in many cases temporary) function of getting the system in operation; and the superintendent of motive power has taken the matter up with the general manager or other superior officer, and obtained his approval and authority for the move. It is as big a matter as that.

METHOD OF INSTALLING NEW SYSTEM.

The equipments, to the tune of $10,000 or $100,000, or more, or less, have arrived, and are in charge of the store department. They have been coming in, wrenches in one lot, oil cans in another, in various consignments for the past six weeks or more. Nothing of those new "standard" equipments has been issued, to be lost track of or misused.

What does our equipment inspector do? He selects two principal points on the main line, on the principal division, and equips the engines operating on the best trains between these two turning points. He has ridden with the engineers of these 2, 4, 8, 12 locomotives, has been friendly with them, has made them interested in the new plan, has (seemingly at least) listened to their suggestions, perhaps humors a whim or so, has made it plain that they are picked out as first to receive these brand-new equipments, as best able to demonstrate the success of the system.

At one of the turning points is a large store. At this point supplies are drawn and placed upon the engine all newly prepared as to boxes, locks, brackets, etc., and full record made of the equipment by a local inspector—one of the two or three or half dozen men who have been collecting data, making inventories, etc., on this very subject for a couple of months previous. He is breaking in an assistant. At the other end is another such inspector who has received a copy of the equipment list of each engine. So these two men, one at each end of the engines' run, watch like hawks for the appearance of the 2, or the 12, that have been equipped preliminarily, and are prompt to follow up any irregularity in the custody or use of articles upon them. It matters not in this connection whether the tools, etc., be locked in boxes on the engine, and there inspected or placed in a box and delivered at a tool or locker room over which the inspector presides—the general method is all the same. For handling a large volume of business the second method is undoubtedly the best.

A few days pass. These first few engines do not "lose" their equipment, though a few annoying circumstances come up. The "assistants"—new men broken in—take up the work; the experienced men are transferred to other points; still the policy of "main line," "best trains" is adhered to as it is easier to keep track of these engines. They are equipped, after the first two weeks or a month, say, at the rate of one engine a day per inspector employed. If there were one inspector employed for every 20 or 30 engines in service (this is for the "first year" only—afterwards it should be one for 40 or 50 engines) the thorough equipment should, theoretically, take only a month. But it will be longer. The branch lines will not be so easy to handle; the freight engines will cause no end of trouble; it will be difficult to secure proper material for inspectors, it will be slow at best "breaking them in." If the organization and the equipment is worked out in three or four months, the thing will have been well done. Then for a month or so the matter will be stationary, while it settles down to being the normal method of operation. Then the less efficient inspectors will be dropped, or transferred to other work—and behold! the system is complete, the ground-work is done! The equipment inspector will have to stay—or some one in his place, to be at the head of the organization, to maintain efficiency. But the capital expense ceases and the returns now come in. Is it not a subject worth at least consideration by more of our railroads?

A FEW USEFUL HINTS.

A few hints may be useful: Don't carry too much on the engine—it is meant to pull a load, not to contain one. Anything which is regularly carried on passenger or baggage coaches, or on cabooses (such as ax and saw, air and signal

hose, wrecking frogs, jacks, etc.), need not be carried on the engine, too.

State laws should be fulfilled.

Every article should be marked plainly with the company initials; the manufacturer is the best one to do this. And it might be well if a little detective work were done in locating company supplies in private homes, or junk shops; railroads are generally regarded as public benefactors and providers in this respect.

Remember that if you attempt to mark each article with an engine (or individual) number, or with the name of an engineer, you are going to have many difficulties, although such markings are perhaps more useful than troublesome.

Any list put up in the cab is bound to get dirty.

Light or cheap locks, and any but bolted hasps and hinges on locomotive boxes and lockers are worse than none, as they are easily (and usually) forced or broken. Get the best locks, or make some other arrangement for safeguarding equipment.

Hostlers should have hammer, torch and screw wrench of their own so they may have no occasion to use the engine crew's kit.

While whatever plan is deemed wisest and decided upon, should be carried out firmly and consistently, one should not be too particular in details in dealing with enginemen; one defeats one's purpose; one gains ill-will rather than co-operation.

There should be real penalties for intentional or careless violation of rules framed for the safeguarding treatment or use of the equipment.

Engineers should be brought to understand that efficient system in this matter is to their lasting assistance and convenience.

Equip all engines; there is then no excuse for stealing from one to the other.

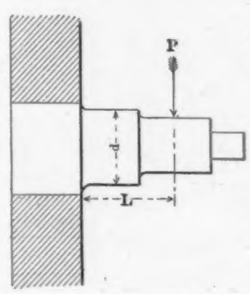
Branch line engines will require more complete equipment than on the main line, being remote from large roundhouse facilities.

Freight engines will be poorest in equipment—and most difficult to keep in equipment, to inspect, to trace.

CRANK PIN AND AXLE CALCULATIONS.

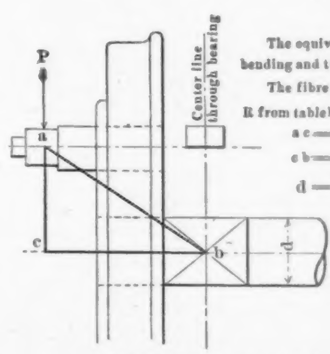
The demand for the June, 1899, issue, containing the crank pin and axle calculations reduced to a "vest pocket basis" by Mr. L. R. Pomeroy has been so great that the article is reproduced here. Additions have been made to the two tables to cover the larger engines which have come into use since the article first appeared. The first table gives the value of the moment of resistance (0.0982 multiplied by the third power of the diameter) for diameters from 3 to 12⅞ ins., advancing by eighths; the second one gives the value of P (piston area times the boiler pressure) for various diameters of cylinders between 12 and 25 ins. and for varying pressures from 160 to 225 lbs. These tables are used in connection with the two diagrams, one giving the formula for calculating the size of the crank pins and the other for driving axles.

One of the large locomotive works has used these formulæ for several years, the method of applying them varying slightly from that above. For crank pins they limit the fibre stresses to 18,000 lbs. for steel and 15,000 lbs. for wrought iron. For simple locomotives the load (P) is taken as the area of the cross-section of the cylinder ½ in. larger in diameter times the boiler pressure. For compound locomotives P = the adhesive weight times the diameter of the drivers divided by 3.5 times the stroke, or P may be taken the same as for simple locomotives using the high-pressure cylinder. The pins are made ⅛ in. larger for wear, and the hub fit for the main pin is made at least ¼ in. larger than the intermediate bearing.



Let P = Boiler pressure x area of piston.
L = Lever arm.
S = Fibre stress.
R = Moment of resistance
= .0982 d^3 (See table.)
M = Bending moment in inch pounds
= P x L. $S = \frac{M}{R}$
$d = \sqrt[3]{\frac{M}{S \times .0982}}$. $R = \frac{M}{S}$.
Opposite "R" in table find "d".

DIAGRAM AND FORMULAE FOR CRANK PINS



The equivalent bending moment M_b (i.e.) combined bending and twisting = ½ P (c b + a b)
The fibre stress $S = \frac{\frac{1}{2} P (c b + a b)}{R}$ (Find value of R from table)
a c = Lever arm for twisting.
c b = Lever arm for bending.
$d = \sqrt[3]{\frac{M}{S \times .0982}}$. $\frac{M}{S} = R$.
Opposite "R" in table find "d".
(N.B. a b can be scaled.)

DIAGRAM AND FORMULAE FOR DRIVING AXLES

FIBRE STRESSES ALLOWABLE.

	Iron. Pounds.	Steel. Pounds.
Driving axles	18,000	21,000
Crank pins	12,000	15,000

MOMENT OF RESISTANCE, $R=0.0982\ d^3$.

	0	⅛ in.	¼ in.	⅜ in.	½ in.	⅝ in.	¾ in.	⅞ in.
3 ins.	2.65	3.00	3.37	3.77	4.21	4.67	5.18	5.71
4 ins.	6.28	6.89	7.53	8.22	8.95	9.71	10.52	11.37
5 ins.	12.27	13.22	14.21	15.25	16.34	17.48	18.67	19.91
6 ins.	21.21	22.56	23 97	25.44	26.97	28.55	30.20	31.91
7 ins.	33.68	35.52	37.42	39.39	41.43	43.53	45.71	47.96
8 ins.	50.28	52.66	55.14	57.68	60.30	63.01	65.78	68.64
9 ins.	71.59	74.61	77.72	80.91	84.19	87.56	91.01	94.56
10 ins.	98.20	101.92	105.74	109.66	113.67	117.78	121.99	126.29
11 ins.	130.70	135.20	139.82	144.53	149.34	154.26	159.30	164.44
12 ins.	169.69	175.04	180.51	186.09	191.79	197.60	203.53	209.58

VALUE OF "P."

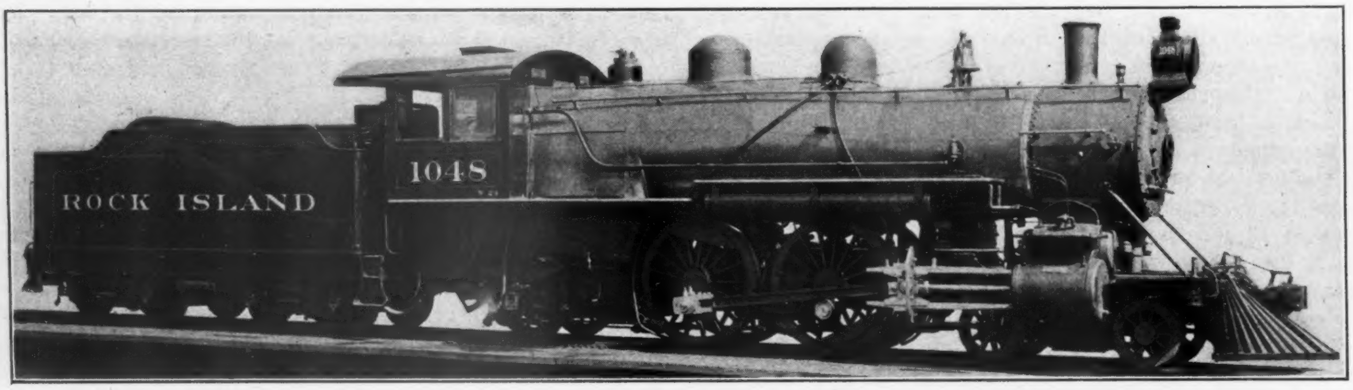
CYLINDER DIAMETER INS.	AREA SQ. INS.	PISTON AREA BY BOILER PRESSURE.											
		160 LBS.	170 LBS.	180 LBS.	185 LBS.	190 LBS.	195 LBS.	200 LBS.	205 LBS.	210 LBS.	215 LBS.	220 LBS.	225 LBS.
12	113.1	18,096	19,227	20,358	20,923	21,489	22,054	22,620	23,185	23,751	24.316	24,882	25,447
14	153.9	24,624	26,163	27,702	28,471	29,241	30,010	30,780	31,549	32,319	33,088	33,858	34,627
16	201.0	32,160	34,170	36,180	37,185	38,190	39,195	40,200	41,205	42,210	43,215	44,220	45,225
17	226.9	36,304	38,573	40,842	41,976	43,110	44,245	45,380	46,514	47,649	48,783	49,918	51,052
18	254.4	40,704	43,248	45,792	47,064	48,336	49,608	50,880	52,152	53,424	54,696	55,968	57,240
18½	268.8	43,008	45,696	48,384	49,728	51,072	52,416	53,760	55,104	56,448	57,792	59,136	60,480
19	283.5	45,360	48,195	51,030	52,447	53,865	55,282	56,700	58,117	59,535	60,952	62,370	63,787
19½	298.6	47,776	50,762	53,748	55,241	56,734	58,227	59,720	61,213	62,706	64,199	65,692	67,185
20	314.1	50,256	53,397	56,538	58,108	59,679	61,249	62,820	64,390	65,961	67,531	69,102	70,672
20½	330 0	52,800	56,100	59,400	61,050	62,700	64,350	66,000	67,650	69,300	70,950	72,600	74,250
21	346.3	55,408	58,871	62,334	64,065	65,797	67,528	69,260	70,991	72,723	74,454	76,186	77,917
21½	363.0	58,080	61,710	65,340	67,155	68,970	70,785	72,600	74,415	76,230	78,045	79,860	81,675
22	380.1	60,816	64,617	68,418	70,318	72,219	74,119	76,020	77,920	79,821	81,721	83,622	85,522
22½	397.6	63,616	67,592	71,568	73,566	75,544	77,532	79,520	81,508	83,496	85,484	87,472	89,460
23	415.4	66,464	70,618	74,772	76,849	78,926	81,003	83,080	85,157	87,234	89,311	91,388	93,465
23½	433.7	69,392	73,729	78,066	80,234	82,403	84,571	86,740	88,908	91,077	93,245	95,414	97,582
24	452 4	72,384	76,908	81,432	83,694	85,956	88,218	90,480	92,742	95,004	97,266	99,528	101,790
25	471.4	75,424	80,138	84,852	87,209	89,566	91,923	94,280	96,637	98,994	101,351	103,708	106,065

VAUCLAIN 4-CYLINDER BALANCED COMPOUND ATLANTIC TYPE LOCOMOTIVE.

CHICAGO, ROCK ISLAND & PACIFIC RAILWAY.

On page 329 of our September issue the standard Atlantic type locomotive of the Rock Island System was described. The Baldwin Locomotive Works have just completed two Vauclain 4-cylinder balanced compound Atlantic type locomotives, which as far as possible are equipped with the Rock Island standard parts, although in redesigning the engines the builders were given full latitude in every particular which would contribute to the success of the design. These engines will be put in service on the Illinois division, which is a very busy one, and will be very carefully tested out in comparison with the large order of standard Atlantic type engines. Comparing the dimensions of the simple and the compound locomotives, it will be noted that the weight on drivers is slightly greater, and the total weight is considerably greater for the compound. The wheel base also varies slightly, while the steam pressure is 35 lbs. greater; the diameter of the first ring in the boiler is slightly smaller, although the heating surface and the grate area are considerably larger.

These engines have about the same tractive power as the



VAUCLAIN 4-CYLINDER BALANCED COMPOUND ATLANTIC TYPE LOCOMOTIVE—CHICAGO, ROCK ISLAND & PACIFIC RAILWAY.

Vauclain 4-cylinder balanced compound locomotive of the same type for the New York Central which was described on page 109 of the April, 1905, issue, and have about 4,000 lbs. less tractive power than similar locomotives for the Erie Railroad which were described on page 177 of our May, 1905, issue. The leading dimensions are as follows:

4—4—2 TYPE VAUCLAIN BALANCED COMPOUND PASSENGER LOCOMOTIVE
CHICAGO, ROCK ISLAND & PACIFIC RAILWAY.

GENERAL DATA.	
Gauge	4 ft. 8½ ins.
Service	Passenger
Fuel	Bituminous coal.
Tractive power	24,000 lbs.
Weight in working order	199,400 lbs.
Weight on drivers	105,540 lbs.
Weight on leading truck	51,780 lbs.
Weight on trailing truck	42,080 lbs.
Weight of engine and tender in working order	about 340,000 lbs.
Wheel base, driving	6 ft. 10 ins.
Wheel base, rigid	16 ft. 2 ins.
Wheel base, total	30 ft. 3 ins.
RATIOS.	
Tractive weight ÷ tractive effort	4.4
Tractive effort x diam. drivers ÷ heating surface	546
Heating surface ÷ grate area	63.9
Total weight ÷ tractive effort	8.3
CYLINDERS.	
Kind	Compound.
Diameter and stroke	15 and 25 by 26 ins.
Valves	Balanced Piston.
WHEELS.	
Driving, diameter over tires	73 ins.
Driving, thickness of tires	3¼ ins.
Driving journals, front, diameter and length	10 by 10½ ins.
Driving journals, back, diameter and length	9 by 12 ins.
Engine truck wheels, diameter	33½ ins.
Engine truck, journals	6 by 12 ins.
Trailing truck wheels, diameter	45 ins.
Trailing truck, journals	8 by 14 ins.
BOILER.	
Style	Wagon top.
Working pressure	220 lbs.
Outside diameter of first ring	66 ins.
Firebox, length and width	107 9-16 by 67¼ ins.
Firebox depth	front, 78½ ins.; back, 66 ins.
Firebox plates, thickness	⅜ and 9-16 in.
Firebox, water space	4½ ins.
Tubes, number and outside diameter	273, 2¼ ins.
Tubes, gauge and length	11, 18 ft. 10 ins. long.
Heating surface, tubes	3,015 sq. ft.
Heating surafce, firebox	194 sq. ft.
Heating surface, total	3,209 sq. ft.
Grate area	50.2 sq. ft.
Centre of boiler above rail	107 ins.
TENDER.	
Wheels, diameter	33½ ins.
Journals, diameter and length	5½ by 10 ins.
Water capacity	7,000 gals.
Coal capacity	12 tons.

PROVISION FOR END SHOCKS IN CAR FRAMING.

BY A. STUCKI, M.E.*

With the introduction of high-capacity cars and the increasing demand for a maximum revenue for money expended in rolling stock, car building has just as much become a theoretical problem as building of locomotives, bridges, machinery, etc. The main object is the carrying of as great a load as possible on a car made as light as possible, consistent with proper strength. This point is generally understood and usually receives the attention it deserves, and the matter was greatly simplified when the M. C. B. Association adopted some standard loads as a basis for the construction of the cars and the interchange between adjoining roads. The car specification, the governing guide between owner, user and builder of the car, always mentions the load which is to be carried and, as a rule, gives the distribution of the load and the fibre stress due to such a static load, thereby defining every detail in this direction.

However, there are other strains coming on the car besides those just mentioned. They are always present when the car is in transit and are caused by what we may term "end shocks." These are very severe at times, and it is safe to say that by far the largest proportion of the damage is done by this class of strains. Notwithstanding this fact, no attempt has been made as yet to agree upon certain service conditions which the cars should be required to meet, and which also could be used as a basis in handling the cars in the yards and the trains on the road, and it is the aim of this paper to indicate a general outline, along which a solution of this whole problem seems practicable, and it will especially deal with the following points: Present service conditions; present car equipment; advantages of a standard to regulate both; best basis for such a standard.

PRESENT SERVICE CONDITIONS.

Owing to the general introduction of the automatic couplers, of longer trains, higher speed, heavier cars and heavier locomotives, the end shocks in service have gradually increased year by year. Complete data as to just what they amount to is, however, not at hand as yet, but we know approximately what strains are created in certain trains handled in certain ways. For instance, the drawbar pull of a heavy locomotive

*Paper read before the Railway Club of Pittsburgh.

of to-day may be considered to be 50,000 lbs. Tensile strains between the cars in long trains, handled carefully, may be regarded as 50,000 lbs.; handled ordinarily, 80,000 lbs., and handled roughly, 100,000 lbs., while the buffing strains can be considered 100,000, 150,000 and 200,000 lbs., respectively. In fact, in a great many cases this figure exceeds 300,000 lbs. In reality there is no limit and no established line as yet whereby a shock can be classified as a service condition or as an accident. (For further figures see the proceedings of the Western Railway Club of May 20, 1902, showing the results of extensive tests made by a committee of which Mr. W. H. Marshall was chairman.) These figures were obtained by the use of a dynamometer car and therefore are reliable as far as they go, inasmuch as the actual condition of the tracks, the locomotive, the draft gear and the stiffeners of the car frame are all taken care of. In fact, there is no other practical way of obtaining correct information on this subject. Since the above tests were made, the writer is not aware of any additional ones carried on in a systematic way.

The question is very important, since in the interchange of cars, 60,000, 80,000 and 100,000 lb. equipment is intermixed in long trains, which means that light constructions and heavy ones are subjected to the same forces, or same end shocks, because the latter, once set up, are actually the same, no matter what the capacity of the car may be. Wooden cars are run between those built of steel, with occasional results well known to us.

PRESENT CAR EQUIPMENT.

Although the entire train is practically subjected to the same end shocks a great difference in strength may be found in the equipment. A good spring draft rigging has now a capacity of about 40,000 to 60,000 pounds and a friction draft gear of possibly 180,000 lbs. The cross sectional area of a shank on a steel coupler is about 12 square inches, while the center sills of one of the hopper cars, a great many of which have been built, have a cross sectional area of 11.31 sq. in. In addition to this, the diagonal braces amount to 1.14 sq. in. in the line of the center sills. This makes a total cross sectional area of 12.45 sq. in. per car. The offset between the center of the coupler and the center of sills amounts to 2½ in., and the body bolster tie-plates have not been figured as assisting the diagonal braces. These cars give very good results in actual service, and if the elastic limit of the steel used is considered as 28,000 lbs. the actual results and the tests above referred to corroborate each other.

One of the large railway systems has recently increased this cross sectional area on hopper cars. On the tank cars, recommended by M. C. B. Association, 30 sq. in. are required in the center sills. In many cases no side sills exist and, the car frame being always as low as possible, there is actually little or no offset between the center of coupler and center of sills. In the cars with wooden underframes there is often a great deal of timber present, and the frequent failures are not at all due to a lack of timber, but are mostly due to the large offset between the center of coupler and center of sills, and also to the fact that a rational connection between the different timbers is almost impossible, and in the critical moments the bolts, instead of strengthening the underframe, tend to split and break up the timber.

A very large number of cars are built and equipped in such a way that it is not safe to run them in the long trains of to-day, and their strength is entirely inadequate for such a service. Many roads realize the danger due to this source and endeavor to protect themselves in making their new equipment to meet the worst conditions. Other roads do not think themselves justified in storing up so much material without getting any revenue from it; however, they are compelled to haul their neighbors' heavy cars without getting any additional compensation. It is also self-evident that their light equipment will have to act as yielding material for the heavier cars, in case the end shocks exceed the capacity of the draft riggings. A standard in this respect is an absolute necessity.

ADVANTAGES OF A STANDARD.

This would at once establish a line at which a car may be considered safe without wasting an excessive amount of material, a guide for those inclined to build strong, and a caution for those in favor of extremely light cars. On the other hand, it is plain that the damage to the rolling stock as a whole would be decreased enormously, first, on account of establishing a certain standard in handling cars and trains, and, secondly, in increasing the minimum strength of the train without increasing its tare weight. This, in turn, would mean: Less work on the repair tracks; greater average mileage per car in a given time; greater average revenue per car in a given time; greater average life per car.

I heard a superintendent of motive power remark the other day that no matter how well a new device is gotten up or how true its underlying principles are, it is not to be recommended unless it will show up on the right side of the balance sheet, and he is quite right. For this same reason a standard in this respect will enable the motive power and mechanical departments to determine whether a construction will really pay, or whether it may mean a loss in the end.

BEST BASIS FOR SUCH A STANDARD.

The next question is: "What should be adopted as a basis in determining the strength of a car lengthwise?" A.—Certain cross sectional area. B.—Certain fiber stress under a certain shock.

If the first plan is adopted it might be a comparatively easy matter, provided each type of car is treated separately. It would, for instance, not be fair to require the same cross sectional area for a gondola car as for a flat car, because the sills in the latter are already heavily strained by the load, while in many gondola cars the sills carry but a very small proportion of the lading. Great care would naturally have to be taken in compensating for the existing vertical offsets between the centers of couplers and sills.

If the latter plan is adopted, and it looks to me as if it should, the question may arise whether the car should be considered loaded or empty, when considering its resistance. Neither case would be correct, and each part of the car should be figured under those conditions which produce a maximum combined fiber stress. In most cases this will happen with the load applied; in some cases the fiber stress will be greatest on an empty car, and again there are cases where the load has no effect whatsoever upon the stresses under discussion. In pursuing this plan (one road entering Pittsburg has done this already) all that would be necessary is to agree upon a certain fiber stress under a certain shock. Inasmuch as these severe concussions fortunately do not occur often, the fiber stress, if produced by said shocks, can be allowed to be much higher than those brought about by the load alone. Such a plan of determining the longitudinal strength of the car has the advantage of being applicable to any type of car, no matter what the construction or the arrangement of the sills may be, and being based on the fiber stress it always discloses the real condition of the car. It may be claimed that this method is laborious. It is to a certain extent, but it only affects the designer who has to figure the different details anyhow, and the writing up of car specifications will be very much simplified. A few sketches will show how it can be figured quickly, and will also suggest in what direction we will have to work in order to get a strong car lengthwise, without unnecessarily increasing its weight.

Fig. 1 shows part of a hopper car. The conditions are very favorable, as the center sills are practically not strained by the load and are ready to exert their entire strength in taking the end shocks. The sills are 12 in. deep, lowered to come central with the coupler and to avoid an eccentric blow. By taking the 25 lb. channel we would get 14.70 sq. in., and counting on five rivets in each end of the diagonal brace passing through 5/16 in. material will amount to $2 \times 5 \times 13/16 \times 5/16 = 2.5$ sq. in. in two braces, and this will, considering the angularity of the braces, be equivalent to an additional cross sectional area in line of the car of 2.0 sq. in., giving a

total of 16.3 sq. in., which, under an end shock of 300,000 lbs., would produce a fiber stress of approximately 18,300 lbs. This seems to be a sufficient strength for an occasional shock, but it may be considered that for this type of car a greater end shock should be figured on as a basis, especially since in the coal trade the cars at times are exposed to a great deal of unreasonable punishment. It will be noticed that the height from top of rail to top of truck bolster is but 25¼ in., which is less than the height of the majority of the trucks now in existence; this height is of vital importance, and a change in this direction by the different roads would increase the life of the cars very materially and would also result in a standard height of truck, which in itself would be of great benefit to all concerned.

Fig. 2 shows an all-steel gondola car with 12 in. center sills. Since the car sides are expected to carry the load, the remarks made above apply here also, but in this case a larger portion of the end shocks will be transmitted to the sides of the car, so that all the material which runs continuously from body bolster to body bolster near the lower edge of the car sides is utilized. In this connection it is very important that the

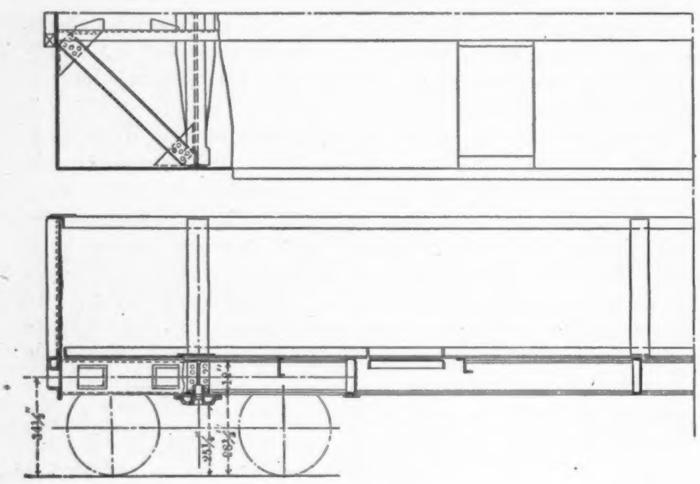


FIG. 2.

splices in the floor sheets and side sheets do not come in line, so as to get as much material as possible to act as a compression column, and the floor sheets near the center sills will also increase the strength in that direction. However, it will be borne in mind that these sheets are not continuous and are liable to be mutilated and partly destroyed in many ways.

Fig. 3 shows a sketch of a 100,000 lb. composite flat car. The center sill consists of a web plate, a cover plate, two top angles and four bottom angles. All members project through the body bolster and are supposed to be well connected with the draft rigging. Here the stresses will run comparatively higher than in the other type of cars, owing to the fact that the sills in the first place have to carry the load, and that the shocks under consideration will increase the fiber strains already present to an alarming degree. Most of the end thrust comes on the center sills. Only a small proportion is transmitted to the channel side sills by the diagonal braces, and the body bolster tie plates are not wide enough to materially enter into this function. The center of coupler is 1½ in. below the center of gravity of the sills at the bolster and 6 in. above the same in the center of the car. The combined maximum stress in the center sills at the body bolster is in the lower edge and is that due to the load, plus that due to the end thrust working on a 1½ in. offset. In the center of the car the maximum combined stress occurs in the upper edge and is that due to the load, plus that of the end shock working on a 6 in. offset. In case 15 in. rolled channels with the maximum offset are to be used, it would be desirous to drop the bottom of the center sills another 1½ in., which, in some cases, may be somewhat troublesome; however, with cast bolsters it can be done successfully. One of the eastern roads has gone much lower, but, as already said, this would not be possible with built-up bolsters. We have another means by which to drop the cars and to bring them in direct line with the coupler, this is a good design of a side-bearing truck, but, not having been tried out sufficiently, it would be premature to suggest the use of same at this time. The scope of this paper does not permit of going into the details of this important subject, and the writer has contented himself by presenting these few figures to illustrate the situation.

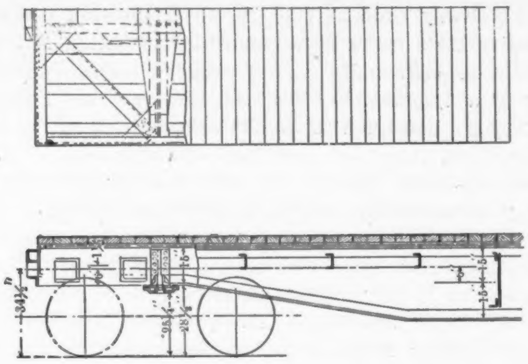


FIG. 3.

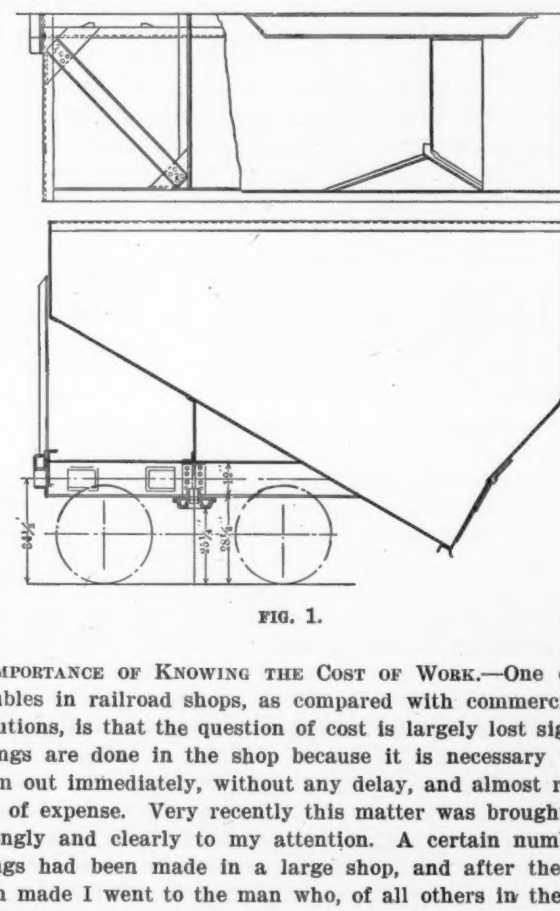


FIG. 1.

IMPORTANCE OF KNOWING THE COST OF WORK.—One of the troubles in railroad shops, as compared with commercial institutions, is that the question of cost is largely lost sight of. Things are done in the shop because it is necessary to get them out immediately, without any delay, and almost regardless of expense. Very recently this matter was brought very strongly and clearly to my attention. A certain number of things had been made in a large shop, and after they had been made I went to the man who, of all others in the shop, ought to have known exactly how much they had cost. He took the paper covering these objects, looked them over carefully, and gave me an estimate of what these particular articles had cost in that particular shop. I took down the figures he gave me, and afterwards went over to the storekeeper and got the actual list and actual statement of the materials. His total was $1,430, and the real total was $5,841. Now, here was a man of good judgment and great skill and long experience, and yet in matters with which he was so well acquainted his judgment was as far astray as these figures indicated. The very first thing that is necessary in shop organization is to know what you are about; to know what things cost and what are the most important things, and the importance of this knowledge is not sufficiently brought to the attention of railroad shop employes.—*Mr. Harrington Emerson, before the Western Railway Club.*

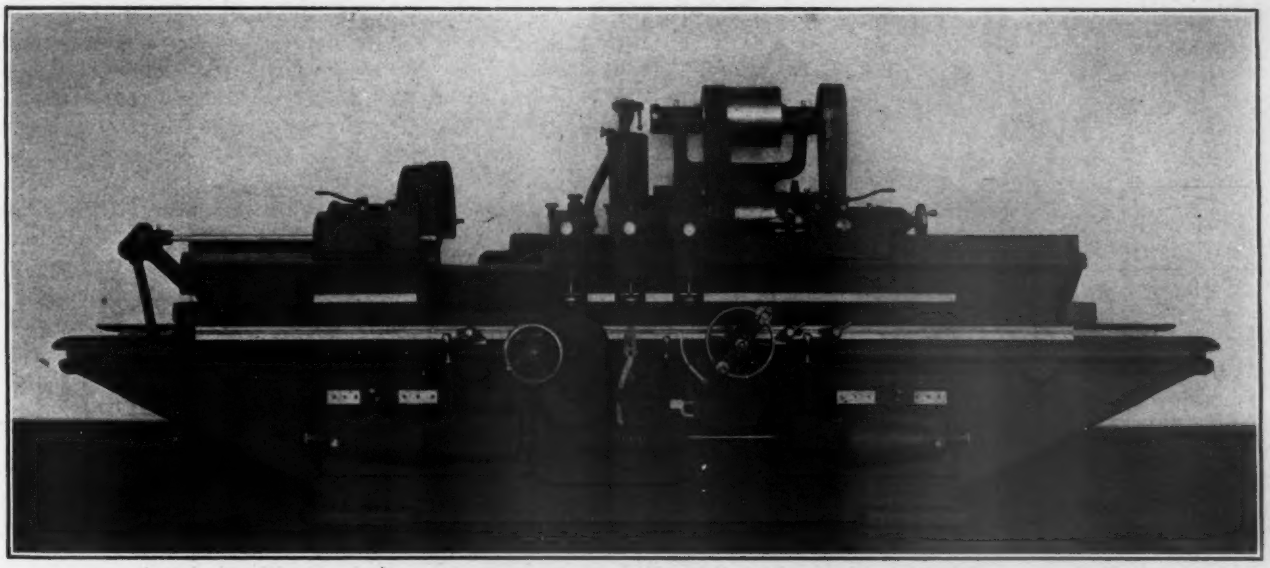
MOTOR DRIVEN GAP GRINDING MACHINE.

It is doubtful if any one type of machine tool has received such thoughtful and careful study to adapt it for work in railroad repair shops as has the Norton gap grinding machine. The accompanying illustrations show a recent motor application to one of these machines. The drive is simple, compact and self-contained, and does not interfere with the passage of cranes. The operator, without moving from his position at the centre of the machine, may instantly change the speed at which the work revolves or stop the work regardless of where the head stock may be or of the length of the work; in fact, he has complete control of the operation of the machine from this point. A 10-h.p. constant speed motor of any make can readily be applied to one of these machines.

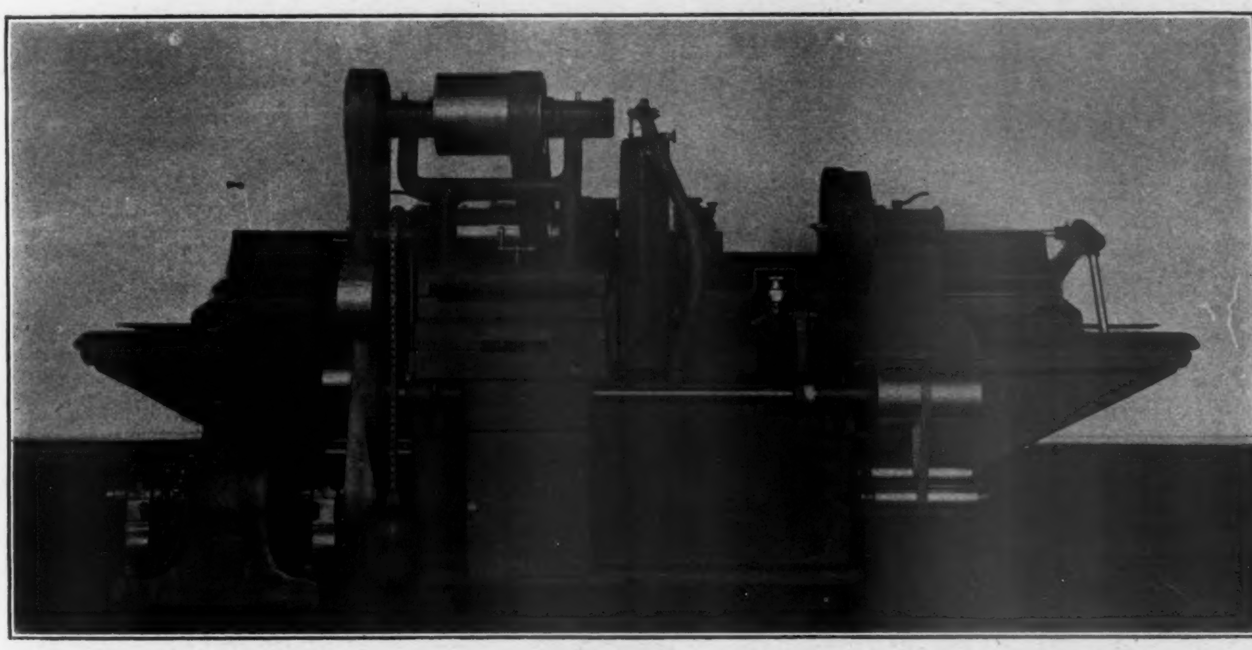
This machine is specially adapted for grinding very heavy work, such as driving and truck axles and crank pins, or for grinding such work as valve stems, the yoke swinging in the gap, or for finishing piston rods, with or without the piston on, the piston swinging in the gap. Worn piston rods with the piston on may be ground smooth and true in from 15 to 20 minutes from the time they are lifted from the floor until they are replaced on the floor, and ordinarily this requires only an average of 6 h.p.; the careful construction and rigidity of the machine, and the fact that Alundum grinding wheels are used, making it possible to do the work with a comparatively small amount of power.

The machine will take work 8 ft. long and swings 18 ins., except in the gap, where the swing is 30 ins. The sliding ways are extraordinarily wide. A cast steel driving plate is used for the work drive. The revolving parts are carefully ground, and all rapid-moving journals are self-oiling and of high carbon steel. The machine weighs about 13,000 lbs..

These machines are in use upon several railroads, and have been thoroughly tried out. On page 145 of our April, 1903, JOURNAL is an article on grinding processes at the Collinwood shops of the Lake Shore & Michigan Southern Railway, in which the work done by one of these machines is considered at length. Additional information concerning the accuracy and increased output due to the use of these machines may be found on page 233 of our June, 1905, issue.



NORTON GAP GRINDING MACHINE.



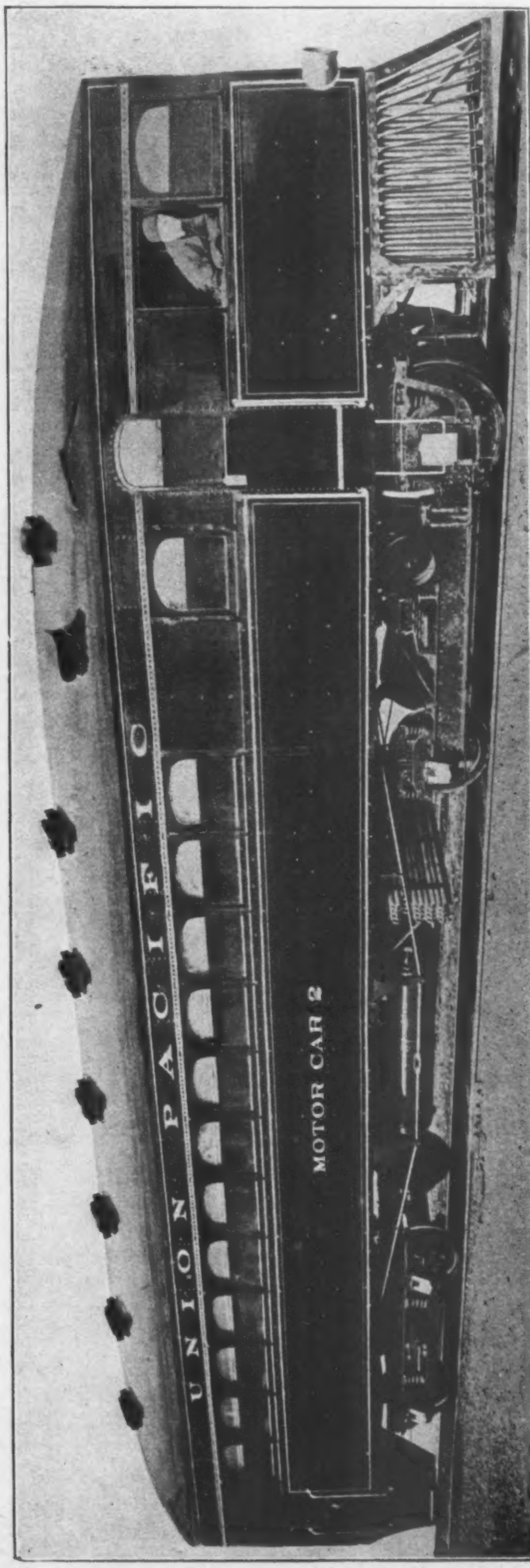
REAR VIEW, SHOWING MOTOR APPLICATION.

It is reported that the Pennsylvania Railroad is investigating the advisability of electrifying the West Jersey & Seashore Railroad between Camden and Atlantic City.

GASOLINE MOTOR CAR NO. 2.

UNION PACIFIC RAILROAD.

This car is considerably larger than car No. 1, which was described on page 294 of our August issue, and has several improvements which were suggested by the tests made with car No. 1. It is 55 ft. long, has two 4-wheel trucks, and seats 57 passengers. It is of the same general design as car No. 1, is of steel construction throughout, and is said to be exceedingly strong for its weight. The car weighs 56,000 lbs., although it is expected that additional cars which are to be built will not exceed 50,000 lbs., as it was very difficult to obtain proper material, and heavier parts were used than necessary.



GASOLINE MOTOR CAR NO. 2—UNION PACIFIC RAILROAD COMPANY.

The car is driven by a 100 h.p. 6-cylinder gasoline engine, designed especially for this purpose. It has a "make and break" spark ignition, with a primary battery for starting and a magneto for regular running service. The lever which controls the metal clutch is operated by air, which is controlled by a specially designed operating valve, by means of which the car may be started at a slow speed and the engine disconnected or thrown into high speed at will. The driving wheels are 43 ins. in diameter, the other wheels are 34 ins., and all are of rolled steel.

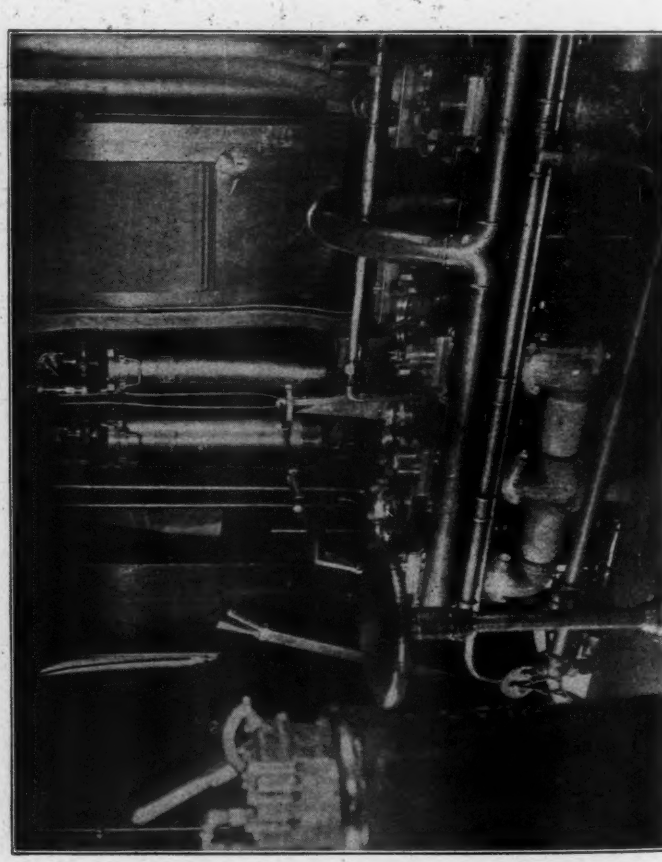
The car is ventilated by means of Cottier suction ventilators. The circulating coils for cooling the gasoline engine are so arranged that during cold weather the fresh air supply for the passenger end of the car may be warmed by passing over them. The car is lighted by acetylene gas and the 25 panel lights are so arranged that while the lighting is very brilliant, it is of a mild and diffused character and not wearisome to the eye. The interior of the car is finished in antique mahogany with a cream white ceiling and decorated in gold and sepia.

The car has been in use since September 14 and is giving very satisfactory results. It accelerates rapidly and is capable of developing a high speed. It was built at the Omaha shops of the Union Pacific Railroad, under the supervision of Mr. W. R. McKeen, Jr., superintendent of motive power, who has invented and patented the important features of construction.

TREATMENT OF HIGH SPEED STEEL.

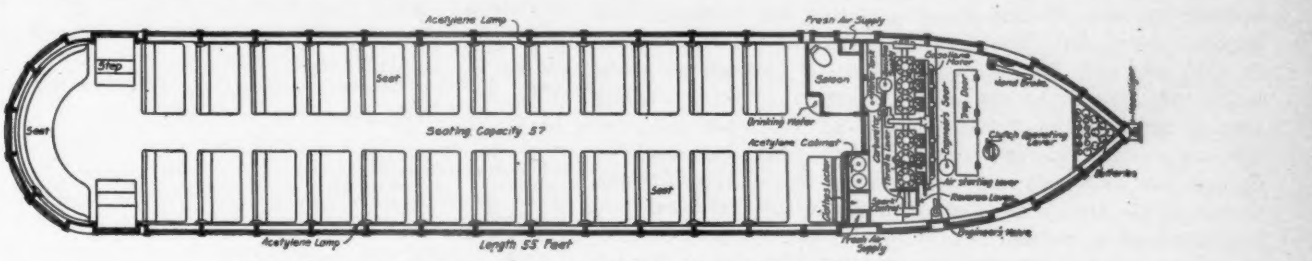
The following is taken from a paper read by Mr. R. A. Mould before the National Railroad Master Blacksmiths' Association:

There is no economy in purchasing a steel just because it is cheap, for with cheap steel we have the difficulties and trials that often arise, the result of which is lost labor and the destruction of an expensive tool. A better quality of steel may cost more in the beginning, but the outcome will be labor saved, because its superior lasting qualities and its ability to retain a cutting edge for long periods makes it the cheapest and most satisfactory. After having selected the grade required for the kind of work, I would recommend the striping of the bars with different colors of paint, then have a card



VIEW IN ENGINE ROOM, GASOLINE MOTOR CAR.

in the steel rack with brand and color corresponding to the color of paint upon the bars of steel. This will enable the workman to obtain the grade desired quickly, and with the certainty that he has the right grade. We can obtain from the steel manufacturer a card recommending the grade of steel as to carbon, in order to meet the requirements of the work, and I would call the attention of the convention to the importance of laying stress upon the instructions given us by the makers of tool steel. While many of us may have wide experiences in the manipulating of carbon steel, nevertheless the instructions given out by the makers have been obtained by the most trying and severe tests, and it is only when we ignore these instructions that we have trouble.



FLOOR PLAN, GASOLINE MOTOR CAR NO. 2—UNION PACIFIC RAILROAD.

The causes of failure in using high-grade steel are numerous. In the first place, the steel may be overheated and overworked in forging, as most of our railroad shops heat their steel in open forges, and unless the greatest care is taken overheated edges and corners are the result. Then, while forging, it may be overworked. First, by working under a steam hammer of insufficient weight, so that the blows do not penetrate the center of the forging, causing piping, and, secondly, working the forging too cold while under the hammer, causing undue strains. When the tap, reamer, die or cutter is finished and comes to be hardened or tempered, the defects arising from the causes already mentioned will then demonstrate themselves, and will often result in the destruction of the tool.


VIEW OF TRUCK, GASOLINE MOTOR CAR.

In order that our labors may bring success in the working of high-grade steel, there are three distinct stages or times of heating. First for forging, second for hardening, and, third, for tempering. The first requisite for a good heat for forging is a clean fire and plenty of fuel, so that jets of hot air will not strike the corners of the billet. Next, the fire should be regular, giving a uniform heat to the whole part to be forged. It should be keen enough to heat the billet as rapidly as possible, and allow a thorough heating. I would suggest the use of a furnace instead of a forge, to avoid the defects mentioned above, the overheating of corners. We should avoid high heating, as the steel cannot be returned to its refined condition unless we have a heavy steam hammer at our command, and sufficient stock in our billet, since heavy forging refines the bars as they slowly cool.

The second stage of heating for hardening requires great care: First, to protect the cutting edges and working parts from heating more rapidly than the body of the tool, and, secondly, the whole to be hardened must be heated uniformly. A uniform heat, as low as will give the required hardness, is the best to insure success. Bear in mind that every variation of heat which is great enough to be noticed will result in a variation of the grain, and the tool may be ruined by inattention to this point. The effect of high heat is to open the grain, making the steel coarse. The effect of an irregular heat is irregular grains, strains and cracks. As soon as a tool is heated it should be thoroughly quenched in plenty of cool bath—water, brine or oil—such as the case may be. An abundance of cooling bath to do the work quickly and uniformly is very necessary to good and safe work. To cool a large tap, reamer, die or cutter, a running stream should be used.

For the third stage of heating, the first important requisite is again uniformity: the next is time. The more slowly a tool is brought down to its temper, the better and safer is the operation. When such tools as taps, reamers, cutters and other expensive tools are to be made, it is a wise precaution to try small pieces of steel at different tempers, so as to find out at how low a heat the required hardness can be obtained. The steel should be of sufficient carbon and uniformity of quality to insure hardness at the lowest possible heat. The test costs nothing, takes but little time, and often saves considerable loss of time and expense.

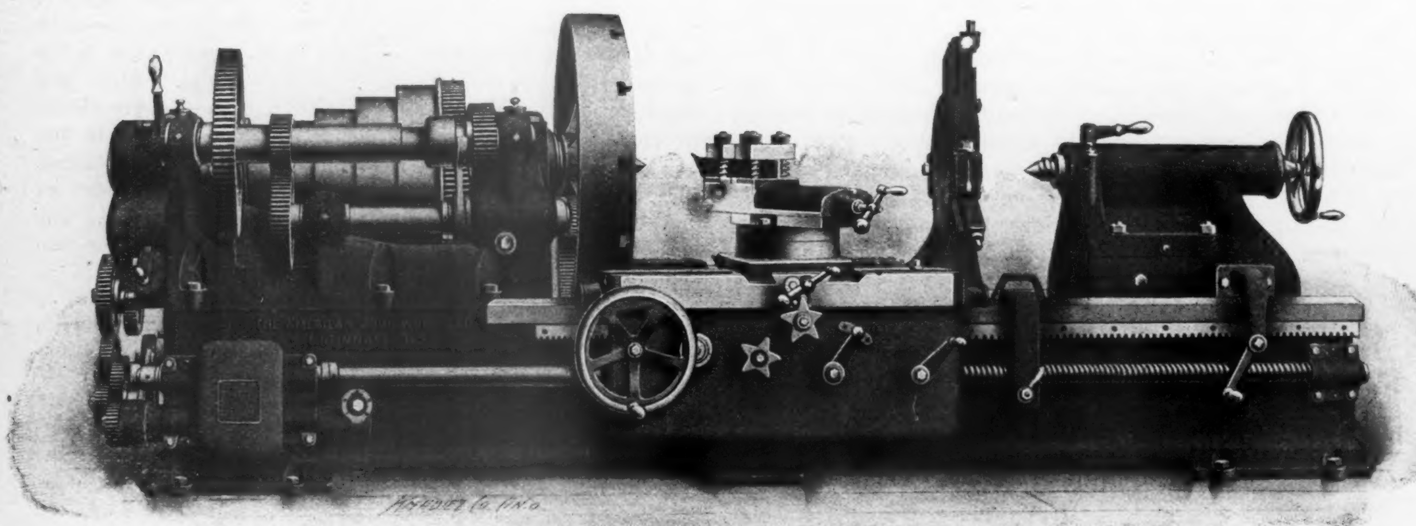
AMERICAN ENGINEER FRONT END TESTS.

During the absence from Purdue University of the experimental locomotive, Schenectady No. 2, which is to be fitted with a Cole superheater, a New York Central Atlantic type engine is to be installed upon the testing plant for use under the direction of the Master Mechanics' committee on front ends. It is the purpose of this committee to repeat upon an engine of large size the experiments made under the patronage of the AMERICAN ENGINEER upon Schenectady No. 2, for the purpose of determining the constants in such equations as may be necessary to the logical design of all portions of the front-end mechanism. The Master Mechanics' committee having the matter in charge consists of Mr. H. H. Vaughan, superintendent motive power, Canadian Pacific Railway, chairman; Mr. F. H. Clark, general superintendent motive power, C., B. & Q. R. R.; Mr. Robert Quayle, superintendent motive power and machinery, C. & N. W. Railway; Mr. A. W. Gibbs, general superintendent motive power, Pennsylvania Railroad; Mr. W. F. M. Goss, Purdue University; Mr. G. M. Basford, American Locomotive Company.

WASTEFUL POWER PLANTS.—Very few railroad companies throughout the country know how much money they are wasting in power plants. There are a few railroad shops with up-to-date power plants, but I will venture to say that nine-tenths of them are behind the time and very wasteful. Some time ago I had occasion to look over a power plant with a view to determining what improvements were necessary, and found that the waste in fuel and labor alone amounted to over 10 per cent. on $180,000 every year. One hundred and eighty thousand dollars would build a strictly up-to-date power plant for a large shop.—*Mr. M. K. Barnum, before the Western Railway Club.*

NEW HEAVY 36-INCH ENGINE LATHE.

The new heavy pattern 36-in. American engine lathe with triple-geared head, illustrated herewith, has several important improvements, including a quick change gear mechanism. This mechanism provides 32 changes for feeding and thread cutting, the range of threads being from one thread in 4 ins. to 16 threads per inch, including 11½ per in. pipe threads. The feeding range is 6.4 to 92 cuts per in. The device is operated by revolving the nut at the right of the gear box beneath the head, which moves a sliding key engaging two opposed gears, each being one of a cone of gears contained in the gear box. These changes may, if desired, be made while the lathe is in operation. The feed or screw pitches thus obtained are multiplied through the compound gears on the quadrant at the end of the head, it being necessary to change one gear only on the quadrant for each additional thread. This arrangement gives flexibility to the screw cutting mechanism, making it possible through the introduction of certain gears to cut an almost unlimited range of special worms or threads either finer or coarser than the range indicated above. Index plates show how to obtain any thread or feed.



NEW AMERICAN HEAVY 36-INCH ENGINE LATHE.

The bed is very heavy and deep and of the drop V pattern, which gives 2 ins. additional swing. It has cross box girders at short intervals for its entire length, and is in addition strengthened by a rack cast in the center for engaging the pawl of the tailstock. The triple gears are of the slip gear type, and may readily be engaged by a rack and pinion at the front of the head. The internal gear is planed integral with the face plate, and the pinion is cut solid with the shaft. Fifteen speeds are obtained in geometrical progression.

The tailstock base is rigidly clamped to the bed, and is also secured against movement by a pawl engaging the rack cast in the center of the bed. It has large continuous bearings on the ways, and may be moved rapidly along the bed by a crank and gear. The spindle has an exceptionally long travel.

The carriage is specially heavy at the bridge, due to the drop V bed, and has a continuous bearing of 50 ins. on the ways. The apron is double, giving all the shafts a double bearing. Both the longitudinal and cross feeds are reversed through a tumbler plate from the front of the apron, and this is a considerable advantage, especially on a long lathe. The top slide of the compound rest is provided with a power angular cross feed with 13½ ins. travel; the swivel is graduated and the top slide and cross feed screws have micrometer dials. The standard length of bed for this lathe is 12 ft., which takes 4 ft. 9 ins. between centers; it swings 38 ins. over the V and 26 ins. over the carriage. This lathe is made by the American Tool Works Company, of Cincinnati.

THE NATIONAL MACHINE TOOL BUILDERS ASSOCIATION.

The fourth annual convention of the National Machine Tool Builders' Association was held at the Hoffman House, New York City, October 16 and 17. This association consists of 45 members, as follows:

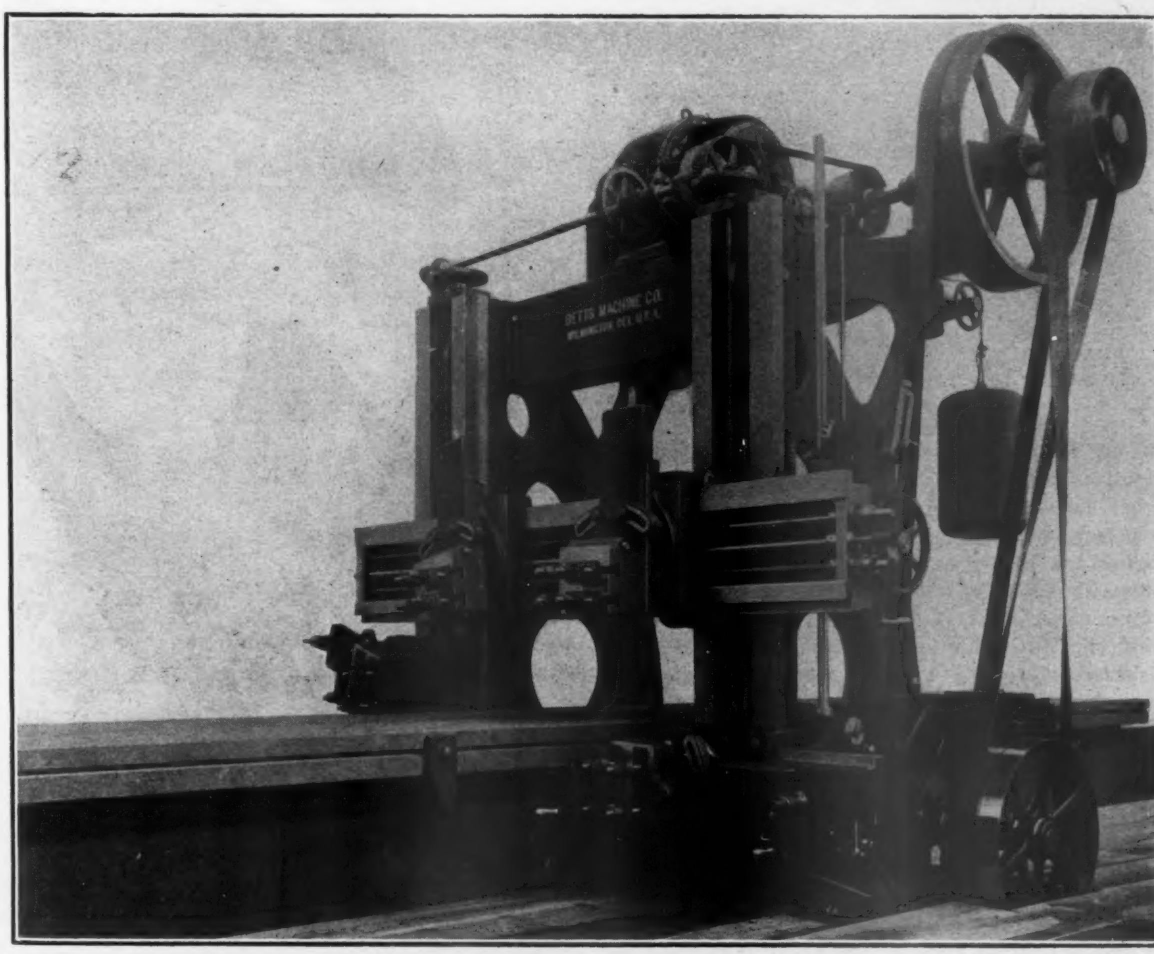
The Hendey Machine Co.	Torrington, Conn.
B. F. Barnes Co.	Rockford, Ill.
Detrick & Harvey Machine Co.	Baltimore, Md.
Baush Machine Tool Co.	Springfield, Mass.
P. Blaisdell & Co.	Worcester, Mass.
Draper Machine Tool Co.	" "
Prentice Bros. Co.	" "
F. E. Reed Co.	" "
Whitcomb Manufacturing Co.	" "
Woodward & Powell Planer Co.	" "
Norton Emery Wheel Co.	" "
Stockbridge Machine Co.	" "
C. E. Sutton Co.	Toledo, Ohio
Flather & Co., Inc.	Nashua, N. H.
Mark Flather Planer Co.	" "
Binsse Machine Co.	Newark, N. J.
Gould & Eberhardt	" "
W. P. Davis Machine Co.	Rochester, N. Y.
W. A. Wilson Machine Co.	" "
The American Tool Works Co.	Cincinnati, Ohio
Bradford Machine Tool Co.	Cincinnati, Ohio
Bickford Drill & Tool Co.	" "
Cincinnati Milling Machine Co.	" "
Cincinnati Planer Co.	" "
Cincinnati Shaper Co.	" "
Dietz Machine Tool Co.	" "
Fosdick Machine Tool Co.	" "
Greaves, Klusman & Co.	" "
Lodge & Shipley Machine Tool Co.	" "
R. K. Leblond Machine Tool Co.	" "
The King Machine Tool Co.	" "
The Queen City Machine Tool Co.	" "
Rahn, Mayer Carpenter Co.	" "
Schumacher & Boye	" "
John Steptoe Shaper Co.	" "
Hamilton Machine Tool Co.	Hamilton, Ohio
Springfield Machine Tool Co.	Springfield, Ohio
Owen Machine Tool Co.	" "
Fairbanks Co.	" "
Jones & Lamson Machine Co.	Springfield, Vt.
The Ridgway Machine Tool Co.	Ridgway, Pa.
G. W. Fifield	Lowell, Mass.
Windsor Machine Co.	Windsor, Vt.
Builders' Iron Foundry	Providence, R. I.
Bullard Machine Tool Co.	Bridgeport, Conn.

The opening session was devoted to the reading of the minutes of the last meeting, reports of standing committees and a discussion of general trade conditions. After the morning session the members of the association and a number of invited guests were tendered a luncheon by the *American Machinist*. The afternooon session was devoted to unfinished business and to the report of the committees on motor drive and on the apprenticeship system. An address was also given by Charles A. Moore on the "Conditions and Possibilities of Trade for American Machine Tools Abroad." No definite conclusions were arrived at in regard to motor drive, the report on this subject being referred back to the committee.

The Tuesday morning session was devoted to unfinished business and to an address by Fred J. Miller on "Government Manufacturing." The following officers were elected for the coming year: President, E. M. Woodward; first vice-president, William Lodge; second vice-president, William P. Davis; secretary, P. E. Montanus; treasurer, F. E. Reed. The next meeting of the association will be held at Atlantic City.

60 INCH MOTOR DRIVEN PLANER.

A 60-in. motor-driven planer has recently been installed at the C., C. & L. Railway shops at Peru, Ind., which has several interesting features. The table is of box section, thus making it very strong and rigid without undue weight; it is 54 in. wide and is driven by steel-cut gearing and a steel rack, and its motion may be controlled from either side of the machine. The driving force is transmitted through heavy sleeves instead of shafts, giving a smooth movement to the table. The machine will take work 61 in. in width and 61 in. high. The bed is well braced with cross girts of box form and the center of the bed through the gearing is of double-box section, making is especially strong at this point. The table V's are equipped with automatic lubricators.



60-INCH BETTS MOTOR-DRIVEN PLANER.

Positive feeds operate the tools at any angle in all four heads. The cross rail is of box-girder form with a deep arched back and is of sufficient length, when using two saddles, to permit of one head planing the entire width between uprights. The cross-rail feed adjustment is at the end of the rail, convenient to the operator. The elevating screws are both of the same hand, insuring parallism with each change of height. The uprights are of double-plate construction, making them very rigid for side cutting. The side heads are counterbalanced and have independent power feeds in either direction. They are of an extension-slide type, so that narrow angular side-head planing may be done at one setting. The tool holders are offset, enabling the two heads to plane close together. The tool clamp bolts slide in the apron, allowing the tool a wide range for adjustment.

The countershaft carried on the uprights is run in ring oil self-adjusting bearings, and is direct connected by means of spur gearing to a 20-h.p. 600 r.p.m. Jantz & Leist motor. Where the motor drive is not used, the driving works may be arranged for the machine to stand parallel or at right angles to the line shaft. This machine was made by the Betts Machine Company, Wilmington, Del.

ELECTRIFICATION OF THE SPOKANE AND INLAND RAILWAY.

A contract has just been closed with the Spokane & Inland Railway Company by the Westinghouse Electric & Manufacturing Company, of Pittsburgh, for the equipment of an electric road, the present terminals of which will be Spokane, Wash., and Moscow, Idaho, 146 miles apart. The roadway is completed from Spokane to Waverly, a distance of 34 miles, and operation will be begun on this as soon as possible.

Each passenger car will be equipped with four 100-h.p. motors, capable of maintaining a schedule speed of 35 to 40 miles an hour. In the freight service four 150-h.p. motors will be used on each car. For the heavy freight service double locomotives, weighing, approximately, 70 to 80 tons, will be used, each consisting of two parts, and each part a complete 35 to 40-ton locomotive. Two or more of these locomotives may be coupled together and operated from the front cab as a single unit. The motor cars and locomotives will all be operated by the Westinghouse multiple unit control system. The motors will operate under three different conditions—6,600 volts alternating current in the interurban districts, 700 volts alternating current in the smaller towns, and 575 direct current in the city of Spokane.

In selecting the equipment for this road, both the alternating-direct-current and the single-phase systems were considered, but, after careful comparison, the single-phase alternating-current system was adopted. Not only did the estimates show a large saving in initial investments and in annual

operating expenses in favor of the single-phase system, but a form of heavy traction is made possible, which would be practically unfeasible with the alternating-direct-current equipment. Besides the passenger traffic, the company is preparing to do a heavy freight business and also to carry mail and express.

NEW CARS FOR THE PENNSYLVANIA RAILROAD COMPANY.

The Pennsylvania Railroad Company announces that orders have been placed for 20,000 freight cars, all of 100,000 lbs. marked capacity. The box cars have steel under-frames, and are to be built to American Railway Association standard inside dimensions. Deliveries are to begin in March, 1906. The number of each class of cars to be built and the distribution of the orders is as follows:

	Lines East.	Lines West.	Total.
Pressed Steel Car Co.:			
Class GLa all steel self-clearing hopper gondola		2,500	
Class Gsd all steel gondola with drop bottom	5,500		
Class XL box car	4,000		
(1,000 to be built at works of Western Steel Car & Foundry Co.)			
Total	9,500	2,500	12,000
American Car & Foundry Co.:			
Class GLa		2,500	
Class XL	600		
Total			3,100
Standard Steel Car Co.:			
Class Gsd	2,000		2,000
Cambria Steel Co.:			
Class Gsd	2,500		2,500
Middletown Car Works:			
Class XL	400		400
Grand Total	15,000	5,000	20,000
Totals by Classes:			
Gsd			10,000
GLa			5,000
XL			5,000
			20,000

Location of Headlights.—In the matter of headlights, since locomotives began to grow to very large dimensions, something has apparently been forgotten and that is that as boilers grow larger, headlights, if placed in the usual location, go higher and higher until in the very largest locomotives of to-day, the height of the headlight is such as to render it practically ineffective, especially in the case of the ordinary variety using oil. In connection with the very large Mallet compound locomotive, built by the American Locomotive Company for the Baltimore & Ohio Railroad and illustrated in this journal in June, 1904, page 237, the location of the headlight was not mentioned, although this is clearly shown in the photograph. The headlight is dropped so that the board is 10 ft. from the rail, whereas if the headlight was put upon the top of the boiler, it would be nearly 14 ft. from the rail. While this is a very large locomotive and the headlight, if placed upon the boiler which is 84 ins. outside diameter, would be extraordinarily high, many locomotives of the present time are far to high for the usual location of the brackets. This matter has probably escaped the attention of many railroad officials and the practice of the Baltimore & Ohio seems to be worthy of wide acceptance.

NEW CARS FOR THE NEW YORK CENTRAL LINES.

Just as we go to press it is reported that the New York Central Lines have ordered 25,000 cars for 1906 delivery. The order is distributed as follows: The Pullman Company, 10,000; Haskell & Barker, 7,500; Pressed Steel Car Company, 3,000; Western Steel Car & Foundry Company, 2,000; American Car & Foundry Company, 2,500.

Electrification of the Erie.—It is reported that the advisability of electrifying districts where suburban traffic is heavy, also for use on the extreme grades between Susquehanna and Deposit, is under consideration.

LOCOMOTIVE AND CAR JOURNAL BEARINGS.

By means of specially formed bearings and the use of a special babbitt metal Mr. Albert C. Stiles, of the A. C. Stiles Anti-Friction Bearing Company, New Haven, Conn., claims to have solved the problem of locomotive and car journal lubrication. He also claims that with the proper quality of metal, the best lubricant and his method of lubrication no babbitt is required on a locomotive driving journal bearing.

The crown of the locomotive driving journal bearing, shown in Figs. 1 and 2, is formed with a longitudinal groove, from which passages lead transversely to longitudinal channels formed in the inner side of the bearing at points considerably removed from the crown. The lubricant is applied through the groove in the crown, and passes through the inner passages to the longitudinal channels at the side opposite to the direction in which the journal revolves, and is carried up

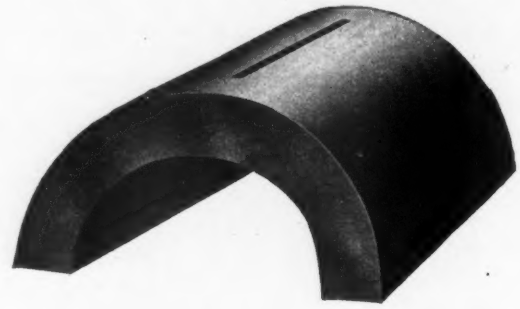


Fig. 2.

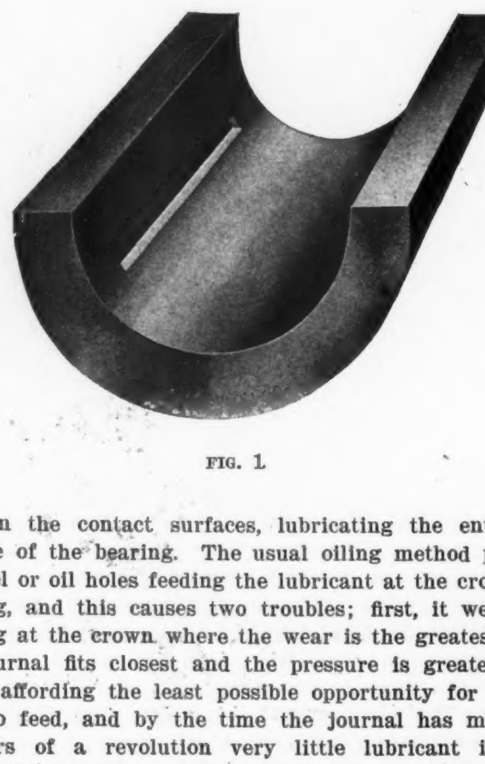


Fig. 1

between the contact surfaces, lubricating the entire inner surface of the bearing. The usual oiling method provides a channel or oil holes feeding the lubricant at the crown of the bearing, and this causes two troubles; first, it weakens the bearing at the crown where the wear is the greatest; second, the journal fits closest and the pressure is greatest at this point, affording the least possible opportunity for the lubricant to feed, and by the time the journal has made three-quarters of a revolution very little lubricant is left on it. With the Stiles method of feeding from the side the oil is fed at a favorable point on the upper thrust, and is carried up over that part of the surface which is most important and most difficult to properly lubricate. If desired, oil channels may be placed on both sides, or the channel on one side may be filled with tallow, which will remain in place until the journal becomes hot, which might occur on account of neglect to furnish oil at the proper time. The tallow would supply lubricant for a time, thus preventing a hot journal.

The Stiles car journal bearing is shown in Fig. 3, and consists of a bronze shell made from a special formula, which is claimed to be of exceptional durability. The bearing of the bronze portion is of the same curvature as the journal, so

that in case the babbitt should be melted out the journal will find a perfectly fitted surface to run in. The method of babbitting is unique. The babbitt is much thicker than ordinarily used, and is interlocked with the shell as shown. The journal is so protected by the babbitt at the sides that it cannot wedge, and will not at any time touch the bronze except at that part which is prepared for its reception. As the bearing wears the journal rests in the bed fitted to it at all times, and even after the bronze shell has begun to wear the journal

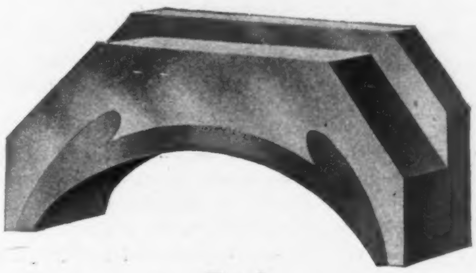


FIG. 3.

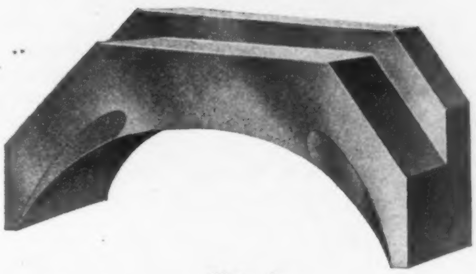


FIG. 4.

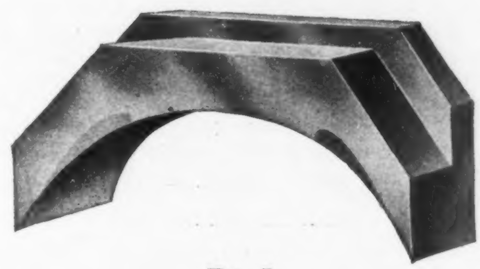


FIG. 5.

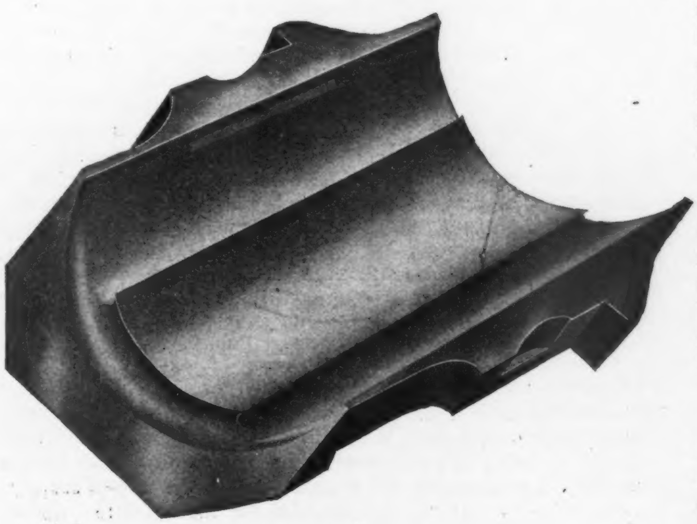


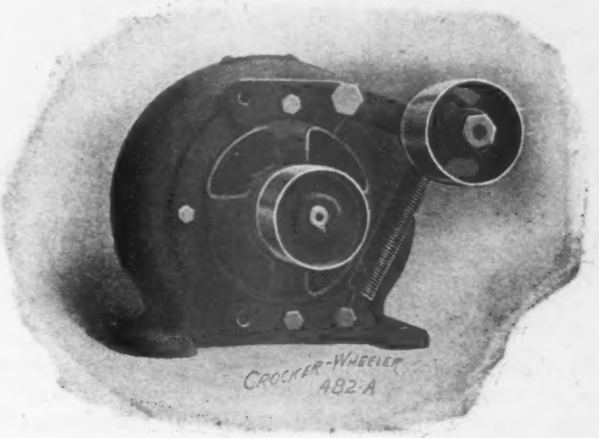
FIG. 6.

is fully protected, as may be seen by Figs. 4 and 5, the latter showing a bearing which ran 72,000 miles. The aim was to produce a babbitt bearing hard enough to carry the necessary weight and be durable and yet soft enough to readily conform to the wearing of the journal. Because of the longer life of such a bearing and the practical elimination of hot boxes, the expense of maintaining it will be greatly reduced. At the present time several roads have ordered trial bearings and are testing them out. Fig. 6 shows the bronze crown of a car journal bearing before the babbitt is applied.

AUTOMATIC BELT TIGHTENING IDLER.

An automatic belt tightening attachment for the standard Crocker-Wheeler form L motor, having a rear end shield, is shown in the accompanying illustration, and may be used wherever the limited center distances between pulleys require an increased belt contact on the pulley surface. Its principal parts are the idler pulley, an arm and block, a spring stud and block and an adjustable spring and hook connecting them.

The idler pulley and arm are pivoted on a stud, which may be screwed into either one of two tapped holes in the block. The block itself may be attached to the motor in any one of four positions by a special screw replacing any one



AUTOMATIC BELT TIGHTENING IDLER.

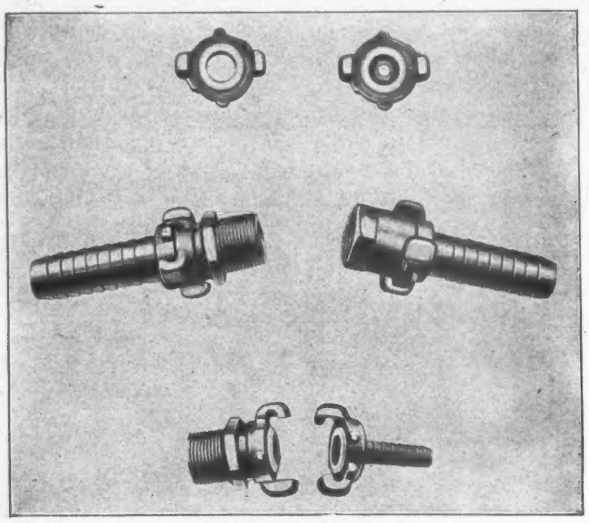
of the four machine screws holding the rear shield to the motor frame. Eight locations are thus afforded for the pivot of the idler arm. The stud to which the spring is anchored may in like manner be screwed into either one of two holes in a block similar to the one just described, and this block may be mounted in any one of the three remaining positions on the rear shield. The position which should be used will depend upon the way the idler pulley rests on the belt. When these parts are put in position, further adjustment may be obtained by screwing the hook in and out of the spring before hooking them on to the attachment. Adjustment for stretch of the belt may also be readily made in this manner at any time.

CEMENT FOR IRON PIPE LEAKS.—A cement for closing leaks in iron pipe consists of coarsely powdered iron borings, 5 lbs.; powdered sal ammoniac, 2 ozs.; sulphur, 1 oz., and water sufficient to moisten it. This composition hardens rapidly; but if time can be allowed it sets more firmly without the sulphur. It must be used as soon as mixed.—*The Mechanical Engineer.*

MAKE CABS CONVENIENT.—A train running at the rate of 60 miles per hour, which is a very ordinary rate of speed for passenger trains of the present time, would travel at the rate of 88 ft. per second; while the engineer turns around for the short space of five seconds to apply an injector his train would have run exactly one-twelfth of a mile, and five seconds is not an excessive amount of time to be used in applying an ordinary injector. This does not apply to the injector alone, but to all of the valves in the cab that have to be operated while the locomotive is in motion. They should all be placed within easy reach of either the engineer or fireman, to avoid the necessity of having to turn around to operate them.—*Traveling Engineers' Association.*

A NEW HOSE COUPLER

The Chicago hose coupler, illustrated herewith, was designed to meet the demand for a standard hose coupler to avoid extra expense for specially constructed couplers to suit the various sizes of hose used with pneumatic tools. Referring to the illustration, it will be seen that it has no male or female parts at the coupling end, but that each half has both male and female features, so that each half is exactly the same and will couple regardless of style and size of shank, making it in every sense of the word a universal coupler.



THE CHICAGO HOSE COUPLER.

With these couplers ¼-in. hose may be coupled with ¾-in. hose, or to anything having one of these couplers attached to it.

The shanks are manufactured for pipe male thread, pipe female thread and hose in standard commercial sizes ¼ in. up to 1 in., which enables all couplings to be made without resorting to reducers or special shanks to meet the conditions presenting themselves where pneumatic tools are in use. They are manufactured by the Chicago Pneumatic Tool Company, who have arranged to carry a large stock constantly on hand, their manufacturing facilities being equal to 500 sets per day.

QUICK OPENING, SELF-PACKING STEAM RADIATOR VALVE

The Crane Company, of Chicago, are placing on the market a new self-packing, quick-opening, steam radiator valve, the self-packing feature eliminating any possibility of the valves leaking at the stuffing box. By means of a special device placed in the stuffing box the packing is automatically kept tight, and will last for years without renewal. The device is very simple, consisting of a vulcanized washer placed in the top of the stuffing box and kept in position by spring compression, which fully compensates for the wear on the washer. The valves open and close by turning the lever handle one-half turn, and this lever handle may be operated by foot as well as by hand. The construction of the valve is such that when closed the discs bear on the seat very tightly and the valve is locked in place until released. The bonnets of these valves are interchangeable with those of the regular Crane radiator valves, and the user may thus at any time equip his old valves with these new improvements.

CRANE SELF-PACKING RADIATOR VALVE.

BOOKS.

The World's Locomotives. By Charles S. Lake. 380 pages. Published by Spon & Chamberlain, 123 Liberty Street, New York. 1905. Price, $4.00.

This is a valuable digest of the latest locomotive practice throughout the world. The most recent types of locomotives are illustrated, and their most important features are considered. The first half of the book is devoted to British locomotives. About 50 pages of the second half are devoted to locomotives in this country. The book contains over 300 illustrations and 8 large plates.

Railway Storekeepers Association. Proceedings of the second annual meeting held at Chicago, May 22-23, 1905.

The large attendance at the meeting (73 members representing 36 roads), the many new members added, the lively and thorough manner in which the various subjects were discussed and the valuable information brought out, indicates that this associaiton is in a most flourishing condition. Motive power officials should carefully read the discussions. Mr. J. P. Murphy, general storekeeper of the Lake Shore & Michigan Southern Railway, Collinwood, Ohio, was re-elected president of the association.

American Railway Master Mechanics Association. Proceedings of the thirty-eighth annual convention, held at Manhattan Beach, N. Y., June, 1905. Edited by the secretary, Mr. J. W. Taylor, Old Colony Building, Chicago, Ill.

In addition to the committee reports, topical discussions and the association rules and standards, are two specially valuable individual papers, one on "The Use of Superheated Steam on Locomotives," by Mr. H. H. Vaughan, and the other on "The Technical Education of Railroad Employes," by Mr. G. M. Basford. As usual, the secretary is to be complimented upon the short time required to get out this report, which covers 411 pages in addition to the plates showing details of the association standards.

Train Resistance and Power of Locomotives. Published by the American Locomotive Company, 111 Broadway, New York.

This publication contains a number of valuable tables and data, showing the tractive power of locomotives per pound of mean effective pressure, the tractive power of locomotives at slow speeds for boiler pressures of 180, 190, 200, 210 and 220 lbs.; piston speeds in feet per minute at 10 miles per hour and the number of revolutions per mile for different wheel diameters; speed factors for calculating tractive power; train resistance for various speeds and grades, horse power for various speeds and grades; speed: seconds per mile in miles per hour; cylinder volumes; heating surface of tubes; weight of tubes; curve ordinates; metric conversion tables, and classification of locomotives. Copies of this publication will be furnished on application to the American Locomotive Company.

Government Regulation of Railway Rates. By Hugo Richard Meyer, assistant professor of political economy in the University of Chicago. 486 pages. Published by MacMillan Company, New York, 1905. Price, $1.50.

The author has made a careful study, extending over twelve years, of the railway question in the United States, Germany, France, Austria, Hungary, Russia and Australia. After reviewing at length the effect of government regulation of railways in foreign countries and studying the development of railways in this country, his conclusion is that "It is impossible for the State to conserve and promote the public welfare by intervening in the regulation of railway rates beyond the point of seeking to abolish secret personal discriminations, guaranteeing that all rates shall be reasonable *per se* and providing that those rates which involve the question of relative reasonableness shall embody compromises which were made with intelligence and in good faith."

Mr. W. G. Rose has been appointed general foreman of the Wabash at Saint Louis, Mo.

PERSONALS.

Mr. G. W. Taylor has been appointed master mechanic of the Atchison, Topeka & Santa Fe at Arkansas City, Kan.

Mr. W. G. Edmondson has been appointed engineer of tests of the Philadelphia & Reading, with headquarters at Reading, Pa.

Mr. P. J. Harrigan, general foreman of the Baltimore & Ohio at Connellsville, Pa., has been appointed master mechanic at that point.

Mr. F. H. Riley has been appointed general foreman of the roundhouse and repair shops of the Chicago & Eastern Illinois at Terre Haute, Ind.

Mr. John Cullinan has been appointed master mechanic of the Central Indiana, with headquarters at Muncie, Ind., succeeding Mr. S. W. Crawford.

Mr. A. McCormick has been appointed master mechanic of the Valley and Arkansas divisions of the Missouri Pacific at Little Rock, Ark.

Mr. W. A. Mitchell has been appointed master car builder of the Missouri, Kansas & Texas, with office at Sedalia, Mo., succeeding Mr. H. A. Bowen.

Mr. John G. Smith has been appointed master mechanic of the Coahuila & Pacific division of the Mexican Central Railway, with office at Saltillo, Coah.

Mr. H. K. Mudd, general foreman of the Wabash at Saint Louis, Mo., has been appointed division master mechanic of the Missouri Pacific at Little Rock, Ark.

Mr. W. J. Schlacks has been appointed superintendent of machinery of the Colorado Midland, with office at Colorado City, Colo., succeeding Mr. J. R. Groves.

Mr. C. J. Bushmeyer has been appointed acting master mechanic of the Denver, Enid & Gulf, with headquarters at Enid, Okla., to succeed Mr. W. E. McEldowney, resigned.

Mr. J. E. Brooks has been appointed acting general foreman of the St. Louis & San Francisco at Monett, Mo., and Mr. George E. Oliver, general foreman at Fort Scott, Kan.

Mr. C. Paskeron has been appointed general foreman of the Eastern Division of the El Paso Southwestern System at Alamogordo, N. M., in place of Mr. T. Fielden, resigned.

Mr. C. L. Bundy, general car foreman of the Colorado & Southern, has been appointed general foreman of the Kaiser Valley shops of the Delaware, Lackawanna & Western at Scranton, Pa.

Mr. A. W. Nelson has been appointed division foreman of the St. Louis & San Francisco at Beaumont Junction, Kan., in place of Mr. William Gibson, who has been transferred to Cape Girardeau, Mo.

Mr. James Ogilvie, heretofore superintendent of motive power of the Canada Atlantic, has been appointed master mechanic of the Ottawa division of the Grand Trunk, with headquarters at Ottawa, Ont.

Mr. C. B. Sumers has been appointed road foreman of engines of the St. Louis division of the Toledo, St. Louis & Western. Mr. M. Marea has been appointed road foreman of engines of the Toledo division.

Mr. S. M. Dolan, division master mechanic of the Missouri Pacific at Baring Cross, Ark., has been transferred to the new shops at Sedalia, Mo., Mr. B. E. Stevens has been appointed to succeed Mr. Dolan as division master mechanic at the Baring Cross shops.

CATALOGS.

IN WRITING FOR THESE CATALOGS PLEASE MENTION THIS PAPER.

VALVE CHARTS.—The Locomotive Appliance Company, Chicago, Ill., in their catalog No. 9 present a number of diagrams, charts and valve motion reports which concern the advantages of the Allfree-Hubbell locomotive.

HEATING APPARATUS.—Catalog No. 186, from the American Blower Company, Detroit, Mich., is devoted to their "A. B. C." heating apparatus, which is adapted for heating and ventilating factories and public buildings and for the drying of materials of all kinds.

NORTHERN FORGE BLOWERS.—The Northern Electrical Manufacturing Company, Madison, Wis., have issued a small leaflet, No. 145, which describes their electric blowers for operating forges. These blowers are made in several different sizes, and are compact and self-contained.

ROTARY CONVERTERS.—Special publication No. 7038, from the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., is devoted to Westinghouse rotary converters, and considers their characteristics and construction, with very complete instructions for their erection, operation and care.

METALLIC PACKINGS.—The United States Metallic Packing Company, Philadelphia, Pa., have issued a catalog describing their metallic packings for locomotive piston rods and valve stems; it also contains some items concerning their care and maintenance and a description of the Gollmar bell ringer.

AIR-COOLED ELECTRIC DRILLS.—Special circular No. 52, from the Chicago Pneumatic Tool Company, Chicago, describes their air-cooled Duntley electric portable drills, and also contains the results of several interesting tests which were recently made with different sizes of these drills, in which ordinary twist drills from ⅜ to 2 15-64 ins. in diameter were worked to the limit of their capacity.

MULTIPLE VOLTAGE.—The Allis-Chalmers Company have just issued bulletin No. 1044, which considers the Bullock multiple voltage system of control for variable speed motors. This system may be used with either three or four wires, and the advantages of the two arrangements are briefly considered. In addition, considerable space is devoted to a comparison of the different variable speed systems. Bulletins Nos, 1040 and 1045 are devoted to the Bullock polyphase induction motors and their construction, and to Bullock rotary converters.

GISHOLT LATHES.—This is the title of a handsome and very completely illustrated catalog received from the Gisholt Machine Company, which describes the various types of their well-known turret lathes, and illustrates a number of typical parts used in connection with various classes of machinery which may be manufactured on these lathes to considerable advantage. Their boring mills and universal tool grinders are also briefly described. This is a separate catalog and is not intended to be bound with the loose leaf bulletins which they issue from time to time.

ELECTRICAL APPARATUS.—Special publication No. 7040, from the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., is devoted to Westinghouse railway apparatus, and considers their direct current and single phase alternating current motors. generators, railway controlling appliances and the Baldwin-Westinghouse electric locomotives. Circular No. 1120 is devoted to their railway motor No. 113 for direct current service, this being the largest capacity motor which has been used for passenger service. Circular No. 1123 considers the Westinghouse prepayment wattmeters.

A MARKED ADVANCE IN LOCOMOTIVE BOILER MAINTENANCE.—A handsome publication with this title has just been sent out by the Kennicott Water Softener Company, Railway Exchange Building, Chicago. It contains a reprint of a paper read before the Western Railway Club by Mr. A. R. Raymer, Assistant Chief Engineer of the Pittsburg & Lake Erie Railroad, in which he described the Raymer boiler water changing device, so successfully used on that road, and told of the advantages which were being gained by its use. The Kennicott Company announce that they have secured exclusive manufacturing and selling rights under the patents granted to Mr. Raymer covering apparatus and methods employed in the construction of this device.

AUTOMATIC BELT TIGHTENING IDLER.—Flyer No. 276, from the Crocker-Wheeler Company, Ampere, N. J., describes a newly-designed automatic belt tightening attachment for their standard form L motor, which may be used wherever the limited distances between pulleys requires an increased belt contact on the pulley surfaces.

JEFFREY ELECTRIC MINE LOCOMOTIVES.—Bulletin No. 10, from the Jeffrey Manufacturing Company, Columbus, Ohio, is devoted to the Jeffrey electric locomotives for mines, which include the ordinary type operating with the overhead trolley system, the Jeffrey gathering locomotives, rack rail locomotives and storage battery locomotives. The bulletin is handsomely illustrated, showing both general views of the large line of locomotives and also the details of some of the more important features.

ELECTRIC CARS.—The most handsome catalog ever issued by a car company has just been received from the J. G. Brill Company, Philadelphia, and presents a valuable record of the most modern types of city and interurban electric cars and trucks. It is 10 by 14 ins., is bound in cloth and contains 90 pages. Forty-five standard cars, representing the foremost types in the various forms of city and interurban service, are illustrated and described, and, in many cases, the most important features are illustrated in detail. Considerable space is also devoted to the general and detail construction of the various well-known Brill trucks. The last few pages are devoted to a number of patent car specialties which this company is prepared to furnish, in addition to repair and supply parts of all kinds.

MILLING MACHINES AND CUTTER GRINDERS.—The Cincinnati Milling Machine Company, Cincinnati, Ohio, are sending out a new 109-page catalog of standard 6 x 9 size. This is one of the most complete treatises on milling machines that has come to our notice, and in addition to a very completely illustrated description of the important details of the Cincinnati millers, contains photographs and specifications of their various machines, and also devotes considerable space to the application of electric motors and to the attachments which they are prepared to furnish for use with their millers. It also contains several speed tables for high speed steel cutters, and as these have been very carefully developed should prove of special value to those who are using these cutters.

GOLD CAR HEATING & LIGHTING COMPANY.—We have just received from the Gold Car Heating and Lighting Company, New York, a handsome catalog, 9 by 12, cloth bound, containing 123 pages. A careful study shows that a number of improvements have been made, both in their steam heating apparatus and the electric heaters. One of the most important improvements is an improved temperature regulator, which affords perfect control of the temperature. This device is very simple, compact, durable and inexpensive and may be applied to any modern heating apparatus. It has been thoroughly tested during the past winter with very gratifying results. A list of 256 railways which use the Gold devices is presented and copies of a few of the many letters of approbation which have been received are reproduced. Nearly 40,000 cars and locomotives are equipped with the Gold heating apparatus. The catalog is very complete and should be in the hands of all those who are interested in car heating, as it forms a valuable contribution to the literature on this subject.

NOTES.

AMERICAN WATER SOFTENER CO.—This company of Philadelphia, report orders for water softening and purifying plants from the Florida East Coast Ry., and the Detroit, Toledo & Ironton Ry.

AMERICAN BLOWER COMPANY.—This company of Detroit, Mich., reports that among other large orders they have received one for the complete heating apparatus for the new Allegheny shops of the Pennsylvania Lines West.

GENERAL ELECTRIC COMPANY AWARDS AT PORTLAND EXPOSITION.—This company announces that they have received a gold medal for the best exhibit in the electrical department, and, in addition to this, they have been awarded 19 other gold medals for various features of their exhibit.

KENNICOTT WATER SOFTENER COMPANY.—This company, of Chicago, announces that they have recently received an order and are at present constructing 18 steel 65,000-gallon storage tanks of the Harriman pattern, for the Union Pacific Railroad.

SAFETY CAR HEATING & LIGHTING COMPANY.—This company, of 160 Broadway, New York, announces that Mr. B. V. H. Johnson, general agent of the company at St. Louis, has been transferred to Philadelphia to take the place of Mr. F. S. Brastow, deceased, and that Mr. Charles B. Adams has been appointed to succeed Mr. Johnson.

FALLS HOLLOW STAYBOLT COMPANY.—This company of Cuyahoga Falls, Ohio, announces that they have secured Mr. F. C. Lippert, 5954a Bartmer avenue, St. Louis, as traveling representative for western territory. They also announce the receipt of large orders for shipment to the American Railroad Company, San Juan, Porto Rico, and to Japan.

O. M. EDWARDS COMPANY.—This company, of Syracuse, N. Y., announces that Mr. W. G. Willcoxson, of 29 Forty-second Place, Chicago, has been appointed to represent them in Chicago. Also, that Mr. E. F. Chaffee, formerly passenger car foreman of the New York Central at the West Albany shops, has been appointed to represent them in the East and will be located at New York.

WM. B. SCAIFE & SONS COMPANY.—This company of Pittsburg, Pa., announces that they have contracts for a larry trestle of steel construction for the Colonial Coke Company in Fayette County, Pa., and also for the structural steel and plate work of a new blast furnace for the Dunbar Furnace Company, Dunbar, Pa. The Washington Coal & Coke Company have contracted with them for the structural steel for a large power plant at Star Junction, Pa.

PRATT & WHITNEY COMPANY.—It is announced that this company has purchased a plant in Dundas, Ontario, for the manufacture of their full line of small tools—taps, reamers, milling cutters, punches, dies, etc. The building is a modern structure and the power plant is already in place. The machinery equipment is being gotten ready at Hartford, and will be sent there and operations begun immediately. The plant will also include a department for manufacturing a full line of twist drills, an elaborate equipment of special machinery having been gotten ready for the purpose. The location of the factory is near that of the John Bertram & Sons Company, which, as has been announced, was recently purchased by the Niles-Bement-Pond Company.

NORTHERN ELECTRICAL MANUFACTURING COMPANY.—The manufacturers who plan the application of the motor drive to machines and machine tools are often unable to make satisfactory progress with the work because of the lack of information necessary to enable the electrical manufacturer to bid on suitable machines. For the electrical manufacturer usually follows a request for quotations with a request for complete and detailed information regarding the motor equipment needed. The Northern Electrical Manufacturing Company, Madison, Wis., is able to send the purchaser quotations on Northern motors for application to machines and machine-tool drives upon learning of the class of work to be accomplished and the voltage of the power circuit from which the current is to be taken. It has had extensive experience in applying motor drives in all kinds of manufacturing plants for increased output and is usually able to determine upon the proper sort of motor equipment to be applied upon learning of the conditions.

MORSE CHAIN COMPANY.—The rapidly increasing business of this company has necessitated the building of a large new plant at Ithaca, N. Y., which will be operated in conjunction with the present factory, situated at Trumansburg, N. Y. The main building, which will contain the general offices, will be 64 x 303 ft. and three stories in height. The first floor will be used for the machine shop. The other buildings to be provided will be one story in height and their general dimensions are as follows: Foundry, 68 x 135 ft.; forge shop, 36 x 86 ft.; pattern shop, 82 x 28 ft.; powerhouse, 105 x 45 ft. Steel and concrete construction has been used throughout and everything has been done to provide for an equipment in keeping with advanced machine shop practice. Gear cutters, boring mills, lathes and general plant equipment to the amount of $50,000 will be installed, a greater portion of which has already been purchased. The machine shop will be equipped with 10-ton electric traveling cranes. The foundry will be equipped with electric cranes of 15 tons capacity, having a span of 50 ft.